

Placer County

Community-Wide and County-Operations 2015 Greenhouse Gas Emissions Inventories With 2005 Baseline Comparison



Final Report

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Executive Summary

This report documents the results of the 2015 greenhouse gas (GHG) emissions inventories for unincorporated Placer County community-wide activities and sources, and the County operations. This report also compares 2015 GHG emissions to 2005 baseline emissions. The Executive Summary presents an overview of the GHG emissions attributed to community activities and sources within unincorporated Placer County, and Placer County's County operations in both 2015 and 2005 for comparison purposes. More detailed discussion of each inventory is provided in the Community-Wide Inventory Results and County-Operations Inventory Results sections.

With the support of Pacific Gas and Electric Company (PG&E), and guidance from County staff, Sierra Business Council (SBC) completed all emissions estimates in accordance with the Local Government Operations Protocol (LGOP) and the United States Community Protocol (USCP), which both outline commonly-accepted methods for performing GHG inventories and are recommended by state agencies for local governments. PlaceWorks provided a peer review of the inventory data and emissions calculations and County staff serving on the Technical Advisory Committee reviewed the activity data and emissions factors used to calculate emissions. More information on the inventory boundaries and the protocols used to develop the inventories is provided in the Inventory Methodologies section of this report.

This report is intended to serve as the baseline for the Placer County Sustainability Plan and as a guidepost to local GHG emissions reduction efforts. Through these efforts and others, Placer County can achieve benefits beyond reducing emissions, including saving community members' and tax payers' money and improving the County's economic vitality and ultimately increasing the quality of life for residents and other community members.

Previously baseline 2005 GHG inventories were completed for Placer County in 2011 and 2012 by Sierra Business Council. Since the inventories were completed, improved methodologies and better data have become available. The improved methodologies rely on more accurate science and the wider availability of some data types. These new methods have been used for the 2015 inventories and to update the original 2005 baseline inventories. This report replaces the original 2005 baseline GHG inventories.

2005 Baseline and 2015 Community-Wide GHG Emissions Summary

In 2015, unincorporated Placer County's residents, businesses, and visitors emitted 1,181,915 metric tons of carbon dioxide equivalent (CO₂e). This is an 18% decrease in GHG emissions from the 2005 baseline inventory's 1,440,913 metric tons of CO₂e. This is primarily the result of reductions in energy use, improvements in utility electricity emissions factors, reductions in water use, and reductions in agricultural activities. In summary:

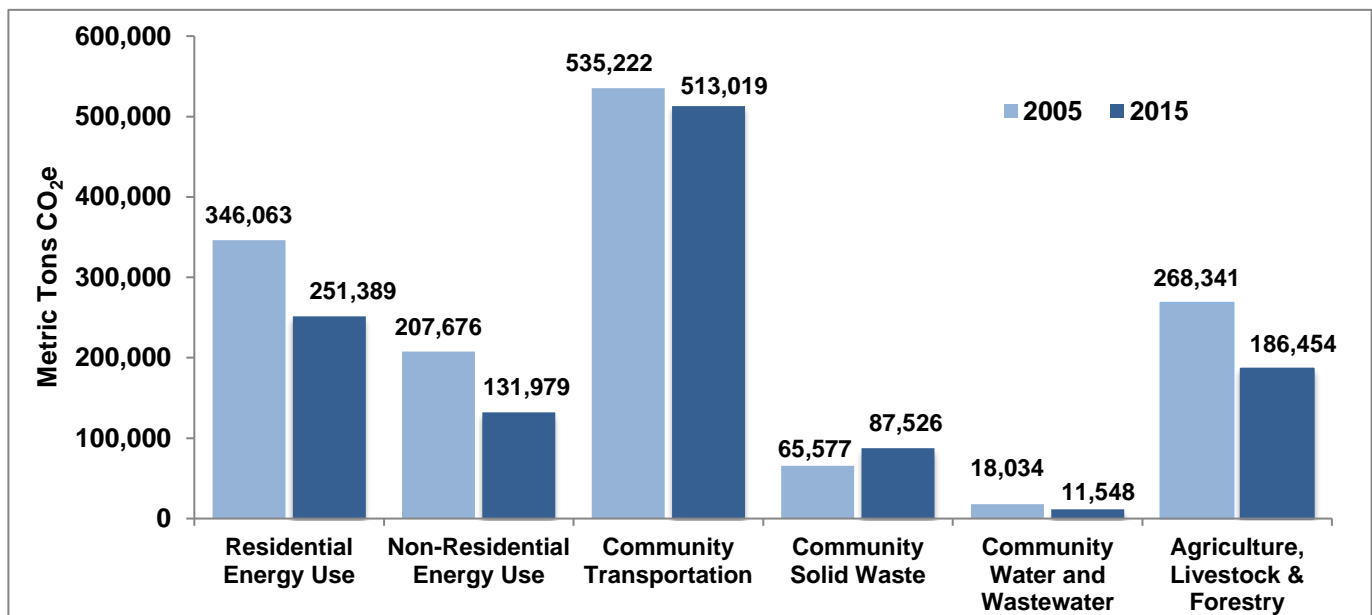
- Total community-wide GHG emissions decreased 18% from 1,440,913 to 1,181,915 metric tons of CO₂e from 2005 to 2015.

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- Over this time, the population of unincorporated Placer County increased 6.5% from 103,528 to 110,214 and employment in the unincorporated county increased 19% from 16,790 to 20,041.
- Over this time, per-capita emissions decreased 23%, and per-service population (combined population and employment) emissions decreased by 24%.
- Emissions from residential and non-residential energy use declined due to reductions in energy use and improvements to utility electricity emissions factors.
- Community transportation vehicle miles of travel increased slightly, although this increase was offset by improvements in vehicle efficiency. As a result, overall emissions declined slightly.
- Annual solid waste volumes generated by the community decreased slightly, although this was offset by an increase in the total amount of waste landfilled at Western Regional Landfill as additional waste was deposited each year. As a result, overall emissions from solid waste increased. Emissions from the landfill are generated in the inventory year from waste deposited in the past.
- Agriculture emissions declined 31% due in large part to a 33% reduction in acres in rice cultivation and a significant decline in the number of livestock.

Figure ES-1 compares 2015 GHG emissions to the updated 2005 baseline GHG emissions.

Figure ES-1: 2005 Baseline and 2015 Community-Wide GHG Emissions



2005 Baseline and 2015 County-Operations GHG Emissions Summary

In 2015, Placer County's County operations generated 49,388 metric tons of CO₂e from sources included in this inventory. This is a 22% increase in GHG emissions from the 40,522 metric tons of CO₂e calculated in the 2005 baseline inventory.

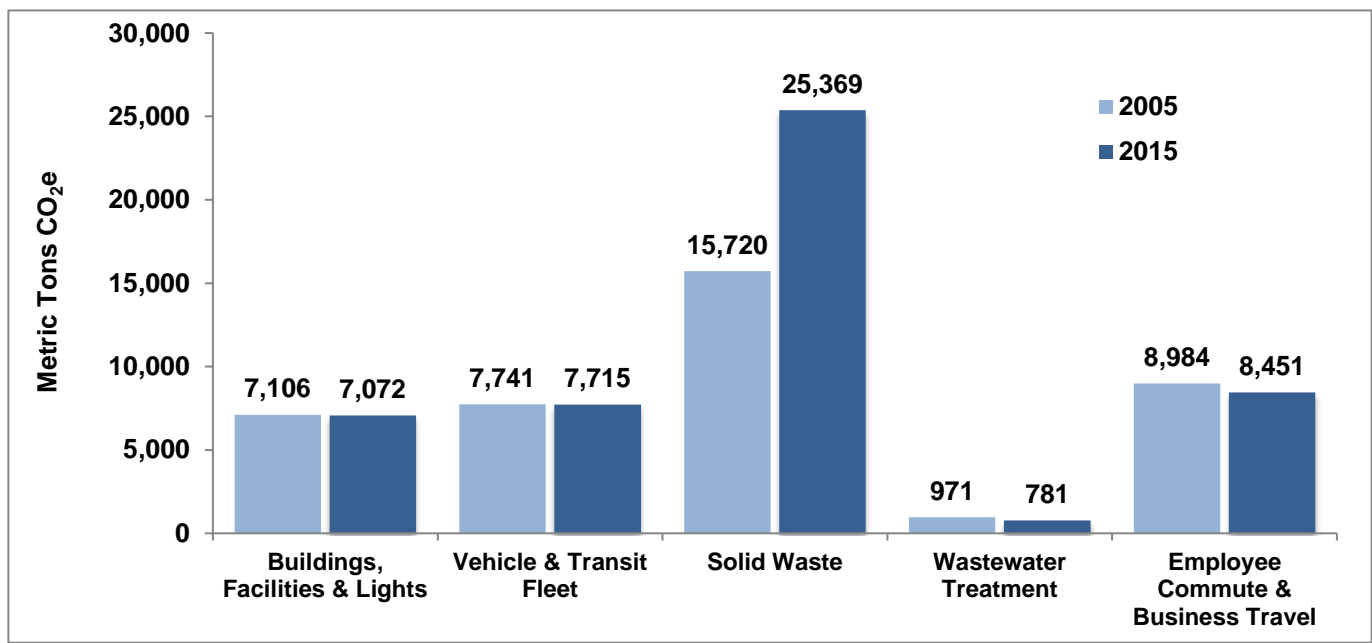
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This is primarily the result of the increase in methane emissions from ongoing waste deposited at the Western Regional Landfill between 2005 and 2015 (even though annual disposal rates decreased). However, this increase is partially offset by cleaner sources of electricity, as well as reduced propane and gasoline consumption by the County's buildings and vehicle fleet. Reductions in electricity use from the installation of solar PV systems by the County have not been quantified for this inventory but are reflected in the reductions in electricity use. The Solid Waste sector is the most significant contributor of emissions in the County-operations inventory because of the high global warming potential of the methane emitted at the Landfill. In summary:

- Total County operations GHG emissions increased 22% (8,866 metric tons of CO₂e) from 2005 to 2015, primarily due to ongoing landfilling of waste at the Western Regional Landfill between 2005 and 2015 resulting in an 61% increase in emissions in the Solid Waste Sector (an increase of 9,648 metric tons of CO₂e). These emissions are generated in the inventory year from waste deposited in the past.
- Over this time, the number of County employees decreased 5% from 2,461 to 2,349 employees.
- The buildings, facilities, and public lighting sector emissions decreased by 34 metric tons of CO₂e from 2005 to 2015, due in large part to lower utility electricity emissions factors, although electricity use increased slightly.
- Vehicle fleet emissions decreased by 721 metric tons of CO₂e from 2005 to 2015, although this was offset by an increase in transit fleet emissions (695 metric tons of CO₂e).

Figure ES-2 compares 2015 GHG emissions to the 2005 Baseline GHG emissions for the County-operations inventory.

Figure ES-2: 2005 Baseline and 2015 County-Operations GHG Emissions



Introduction

California's governments, businesses and the general public are placing increasing focus on quantifying and reducing greenhouse gas (GHG) emissions. California's legislature and regulatory agencies have established policies relating to GHG emissions reductions. Due to these drivers and other motivations, Placer County, with the support of PG&E, is updating their 2005 baseline GHG inventories and conducting updated 2015 inventories, both community activities and sources, and the County's municipal operations. This report documents the findings and methodologies of the new 2015 community-wide and County-operations inventories and provides a comparison to the updated baseline 2005 GHG emissions.

With the support of Pacific Gas and Electric Company (PG&E), and guidance from County staff, Sierra Business Council (SBC) completed all emissions estimates in accordance with the Local Government Operations Protocol (LGOP)¹ and the United States Community Protocol (USCP)², which both outline commonly-accepted methods for performing GHG inventories and are recommended by state agencies for local governments. Place Works provided a peer review of the inventory data and emissions calculations and County staff serving on the Technical Advisory Committee reviewed the activity data and emissions factors used to calculate emissions. More information on the inventory boundaries and the protocols used to develop the inventories is provided in the Inventory Methodologies section of this report.

Inventory Methodologies

This section provides information on the protocols used to guide the Placer County Greenhouse Gas Inventories, including improvements to the 2005 baseline GHG inventories' methodologies. The updated 2005 baseline and new 2015 inventories use consistent and current methods described in this section.

U.S. Community Protocol

The USCP was released by the organization ICLEI in October 2012, and represents the current national standard in guidance for community-wide GHG emissions inventories. The baseline inventory used the previous standard, called the International Local Government GHG Emissions Analysis Protocol. The USCP improved on this earlier protocol by establishing additional reporting requirements for community-wide GHG emissions inventories and providing improved accounting guidance for quantifying GHG emissions. The improvements to inventory methodologies from the USCP include the addition of electricity transmission and distribution losses, the delineation of community wastewater and potable water energy use emissions, improved methods to estimate residential non-utility fuel use emissions and improved

¹ <https://www.theclimateregistry.org/tools-resources/reporting-protocols/local-goverment-operations-protocol/>

² <http://icleiusa.org/publications/us-community-protocol/>

Placer County GHG Emissions Inventories

methods to estimate wastewater process emissions. The State of California Governor's Office of Planning and Research recommends that California local governments follow the USCP when undertaking their greenhouse gas emissions inventories.

Local Government Operations Protocol

The Local Government Operations Protocol (LGOP) was released in 2008, by ICLEI, ARB, and the California Climate Action Registry (CCAR) to serve as the national standard for quantifying and reporting GHG emissions from local government (or municipal) operations. The purpose of the LGOP is to provide the principles, approach, methodology, and procedures needed to develop a municipal-operations GHG emissions inventory. The LGOP was used to guide the Placer County County-Operations GHG inventories.

Greenhouse Gas Global Warming Potential

Greenhouse gas emissions are commonly aggregated and reported in terms of equivalent-carbon-dioxide-units, or CO₂e. This standard is based on the Global Warming Potential (GWP) of each gas, which is a measure of the amount of warming a GHG may cause over a 100-year time horizon, measured against the amount of warming caused by carbon dioxide. Converting all emissions to equivalent-carbon-dioxide-units allows for the comparison of different GHGs in similar terms. Table 1 presents the GWPs of the commonly occurring GHGs according to the Intergovernmental Panel on Climate Change's 5th Assessment Report³, reflecting the most recent scientific consensus, and the 3rd assessment values that were used previously for 2005 inventories.

Table 1: Greenhouse Gas Global Warming Potential

Greenhouse Gas	Chemical Formula	3rd Assessment GWP ⁴	5th Assessment GWP ⁵
Carbon Dioxide	CO ₂	1	1
Methane	CH ₄	21	28
Nitrous Oxide	N ₂ O	310	265
Hydrofluorocarbons	Various	43-11,700	4-12,400
Perfluorocarbons	Various	6,500-9,000	6,630-17,400
Sulfur Hexafluoride	SF ₆	23,900	23,500

³ https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf

⁴ Used for previous 2005 inventory.

⁵ Used for 2015 inventory and updated 2005 inventory.

Sources and Activities

The USCP defines a community's greenhouse gas emissions in two categories as described in Table 2: 1) GHG emissions that are produced by "sources" located within the community boundary, and 2) GHG emissions produced as a consequence of community "activities" that may be produced within or outside of the community boundary.

Table 2: Source vs. Activity

Source	Activity
Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere (for example, natural gas combusted at homes and business)	The use of energy, materials, and/or services by members of the community that result in the creation of GHG emissions that may be outside of the community boundaries (for example, electricity used at homes and business)

By reporting on both sources and activities, local governments can develop and promote a deeper understanding of GHG emissions associated with their communities. A purely source-based emissions inventory could be used to estimate total emissions released within the community's jurisdictional boundary. In contrast, a purely activity-based emissions inventory could provide perspective on the efficiency of the community, even when the associated emissions occur outside the jurisdictional boundary. Sometimes an emissions category could be considered a source and an activity, for example, fuel used for heating is both a source of emissions within the community as well as a result of community activity. In cases such as this, the emissions are considered a source/activity because the emissions are known to have originated from within the community. The division of emissions into sources and activities for community-wide inventories replaces the scopes framework that is used in County-operations inventories.

Information Items

Information Items are GHG emissions that are not included in the GHG emissions totals, though are reported to provide context. Information Items are reported separately from the totals either to avoid overlap with other reported emissions or because they are excluded from GHG inventories by Protocol guidance. Information Items can include emissions such as:

- Biogenic CO₂ emissions from the combustion of wood used for power generation, home heating, and from agricultural residue and forest biomass burning. Biogenic CO₂ is not included in emissions totals because the same CO₂ would be produced if the wood or other organic material were left to decompose naturally.
- Emissions associated with electric vehicles in the Community Transportation sector. The emissions are included in residential and non-residential electricity emissions totals.
- Collection and transportation of community-generated solid waste in the Community Solid Waste sector. The emissions are included in community transportation totals.
- R-12 refrigerants which are ozone depleting substances currently being phased out worldwide.

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- Public lighting operations paid for by the County but owned and operated by PG&E.
- Community-generated solid waste collected by the County as a service, but not generated by county operations. For example waste collected from park cans over which the County has no control.
- Business travel via County-owned vehicles. The emissions are included in the County vehicle fleet totals.

Statewide Energy Efficiency Collaborative

The Statewide Energy Efficiency Collaborative (SEEC) provides support to cities and counties to help them reduce GHG emissions and save energy. SEEC is an alliance between three statewide non-profit organizations and California's four largest investor-owned utilities. SEEC provides education and tools at no cost to representatives of local governments within California, as well as to state and regional government agencies, special districts, and school districts. This inventory leveraged the expertise and tools provided by SEEC. All SEEC tools are available at no cost to local California governments and their representatives at www.californiaSEEC.org.

ClearPath California

To facilitate efforts to measure GHG emissions as a first step towards reducing them, ICLEI, on behalf of SEEC, developed ClearPath California⁶. ClearPath provides a no-cost, easy-to-use online tool for California local governments to calculate, monitor, and forecast community-wide and County-operations GHG emissions, based on reported activity data and demographic information. ClearPath was developed to assist in the preparation of USCP and LGOP-compliant GHG inventories. The baseline GHG inventories have been updated using ClearPath California as part of this inventory process.

Cool California Household Carbon Calculator

It is important to understand that this inventory is not the same as the carbon footprint of the average individual or household living in unincorporated Placer County, which includes different activities and emissions not included in this inventory, such as upstream emissions from the consumption of goods and services by community members. For comparison purposes, a household consumption-based GHG emissions metric for Placer County for 2017 can be estimated using the Cool California Household Carbon Calculator available at www.coolcalifornia.org. Cool California helps residents and businesses to develop a simplified consumption-based GHG inventory to calculate their individual carbon footprint and learn ways to reduce their personal carbon footprint while saving money in the process.

⁶ <http://californiaseec.org/seec-clearpath/>

Community-Wide Inventory Results

The community-wide inventory is an assessment of Placer County's greenhouse gas (GHG) emissions resulting from activities and sources in the unincorporated County as a whole in 2015 and 2005. The community-wide inventory was conducted under the USCP strongly recommended Local Government Significant Influence framework. This framework includes emissions from the five USCP required activities (electricity use by the community, stationary fuel use by the community, on-road community transportation, use of energy for potable water delivery and wastewater treatment, and generation of solid waste by the community), as well as additional sources and activities (electricity transmission and distribution (T&D) losses, off-road vehicles and equipment used by the community, landfill emissions in the unincorporated County from waste deposited in the past, community wastewater treatment process emissions, and agriculture and livestock emissions in unincorporated Placer County) that the County has influence over through ownership, budgetary authority, education, outreach, incentives or regulatory policies and programs. For more information on the Local Government Significant Influence framework and specific inventory methods please refer to the USCP section 2.3.2.

Emissions Summary

In 2015, unincorporated Placer County's residents, businesses, and visitors emitted 1,181,915 metric tons of CO₂e. This is an 18% decrease in GHG emissions from the 2005 baseline inventory's 1,440,913 metric tons of CO₂e. This is primarily the result of reductions in energy use, improvements in utility electricity emissions factors, reductions in water use, and reductions in agricultural activities.

A 2005 baseline community-wide GHG inventory was completed for Placer County in 2012 and updated in 2013. Since the 2013 inventory, improved methodologies have become available. The improved methodologies were used for the 2015 inventory and to update the 2005 baseline results. This report replaces the original 2005 baseline inventory report. Details on the updates to the 2005 baseline community-wide inventory are explained in the Inventory Methodologies section. This section of the report compares 2015 GHG emissions to the updated 2005 baseline GHG emissions. In summary:

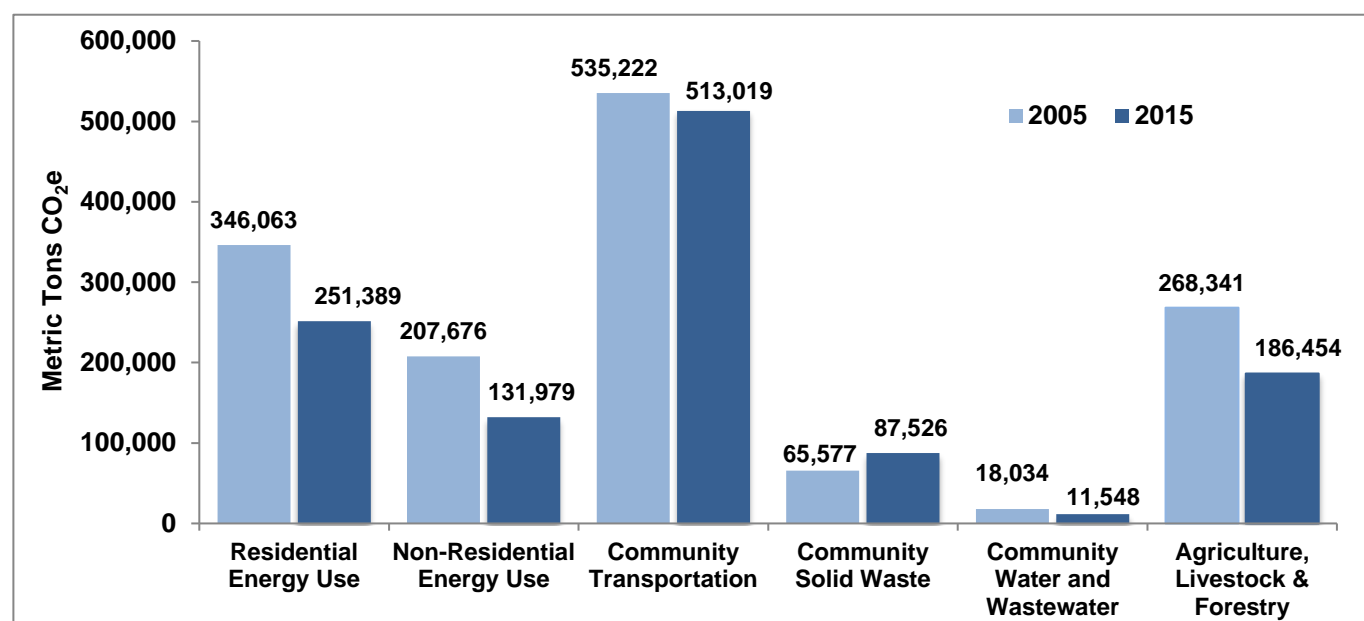
- Total community-wide GHG emissions decreased 18% from 1,440,913 to 1,181,915 metric tons of CO₂e from 2005 to 2015.
- Over this time, the population of unincorporated Placer County increased 6.5% from 103,528 to 110,214 and employment in the unincorporated County increased 19% from 16,790 to 20,041.
- Over this time, per-capita emissions decreased 23%, and per-service population (combined population and employment) emissions decreased by 24%.
- Emissions from residential and non-residential energy use declined due to reductions in energy use and improvements to utility electricity emissions factors.

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- Community transportation vehicle miles of travel increased slightly. This increase was offset by improvements in vehicle efficiency resulting in a slight reduction in emissions.
- Annual solid waste volumes generated by the community decreased slightly, although this was offset by an increase in the total amount of waste landfilled at Western Regional Landfill as additional waste was deposited each year. As a result, overall emissions from solid waste increased. Emissions from the landfill are generated in the inventory year from waste deposited in the past.
- Agriculture emissions declined 31% due in large part to a 33% reduction in acres in rice cultivation and a significant decline in the number of livestock.

Figure 1 summarizes the comparison of 2015 GHG emissions to the 2005 baseline GHG emissions for the community-wide inventory.

Figure 1: 2005 Baseline and 2015 Community-Wide GHG Emissions



Residential Energy Use

Placer County's residential energy use generated 251,389 metric tons of CO₂e in 2015, primarily from electricity and natural gas use. This is a 27% decrease in GHG emissions from the 346,063 metric tons CO₂e in 2005. This decrease is partially the result of reductions in energy use (except for wood use, which increased) and partially the result of an increased supply of electricity from renewable and other lower carbon electricity sources. The residential energy-use emissions were calculated using electricity and natural gas use data provided by utilities and the California Energy Commission, and non-utility fuel use (including propane, fuel oil/kerosene, and wood) estimates based on U.S. Census Bureau data and California average per-household fuel use data. Reductions in electricity use from the installation of solar PV systems by residences

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in the unincorporated County have not been quantified for this inventory but are reflected in the reductions in utility electricity use.

Propane (LPG), fuel oil, kerosene and wood are commonly used in residences as an alternative fuel for natural gas, for activities such as home heating, water heating, and cooking. Biogenic emissions from wood combustion are reported as an Information Item. Biogenic CO₂ is not included in emissions totals because the same CO₂ would be produced if the wood were left to decompose as part of the natural carbon cycle.

Emissions from fuel used for portable residential equipment, such as emergency generators and landscaping equipment, is included in the off-road equipment emissions in the Community Transportation Sector. Energy-related GHG emissions associated with residential transportation, solid waste, and water and wastewater are accounted for in the community transportation, community solid waste, and community water and wastewater treatment emissions totals, respectively. Benefits from hydropower production in the unincorporated County (e.g. Middle Fork Project) are incorporated into the utility emissions factors and reflected in electricity emissions. The Middle Fork Project ownership is split 50/50 between Placer County and Placer County Water Agency (PCWA). Appendix A provides detailed residential energy use data, emissions factors and calculation methods.

Table 3 and Table 4 illustrate the breakdown of residential energy use and GHG emissions.

Table 3: 2005 Baseline and 2015 Residential Energy Use Data

Residential Energy Use	2005	2015	Percent Change
Electricity Use (kWh)	519,736,679	475,910,421	-8%
Electricity T&D Losses (kWh)	29,279,007	23,942,978	-18%
Natural Gas Use (Therms)	18,434,206	17,262,355	-6%
Propane Use (Gallons)	8,545,439	5,743,410	-33%
Fuel Oil / Kerosene Use (Gallons)	177,070	65,983	-63%
Wood Use (Cords)	25,158	40,350	60%

Table 4: 2005 Baseline and 2015 Residential Energy Use Emissions

Residential Energy Use	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
Electricity Use	181,107	110,380	-39%
Electricity T&D Losses	10,110	6,893	-32%
Natural Gas Use	98,045	91,812	-6%
Propane Use	49,979	33,591	-33%
Fuel Oil / Kerosene Use	1,810	674	-63%
Wood Use	5,012	8,038	60%
Total Residential Energy Use	346,063	251,389	-27%

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Information Items			
Biogenic Emissions from Wood Use	47,196	75,696	60%

Non-Residential Energy Use

Unincorporated Placer County's non-residential energy use generated 131,979 metric tons of CO₂e in 2015. This is a notable 36% decrease in GHG emissions from the 207,676 metric tons CO₂e in the 2005 inventory. This is primarily the result of improvements in the utilities' emissions factors between 2005 and 2015 (although electricity use increased slightly), and a significant decrease in natural gas use. Reductions in electricity use from the installation of solar PV systems by businesses in the unincorporated County have not been quantified for this inventory but are reflected in the reductions in utility electricity use.

The electricity emissions do not include those from electricity used within the unincorporated county boundary for potable water and wastewater treatment services, which are reported separately, per USCP guidelines, to provide context on the water-energy connection. Potable water and wastewater treatment electricity use emissions are located in the Potable Water and Wastewater Treatment Sectors.

Annual non-residential electricity use (excluding water and wastewater treatment use) increased 2% between 2005 and 2015, while natural gas use decreased an estimated 34%. Records of propane use are not available for most facilities and there is no feasible way of estimating non-residential propane use. These activities and their resulting emissions are therefore not included, although note that propane use can result in substantial emissions. Data was available for propane used by small number of large facilities that are required to report their emissions to the Placer County Air Pollution Control District (PCAPCD). This data, obtained from the PCAPCD, is included as an information item since the reported use of a small number of facilities is not an accurate estimate of the total propane use in the unincorporated County. Also included for information purposes only are emissions from the Rio Bravo Power Station, which burns wood waste. The significant emissions are primarily biogenic, but the non-biogenic emissions are also reported as an information item because the power produced is sold to PG&E, so the emissions are accounted for in PG&E's electricity emissions factors. Benefits from hydropower production in the unincorporated County (e.g. Middle Fork Project) are incorporated into the utility emissions factors and reflected in electricity emissions.

Emissions associated with non-residential mobile equipment (e.g. generators, forklifts and grounds keeping equipment) are included in the off-road equipment emissions estimates in the Community Transportation Sector. GHG emissions associated with non-residential transportation, solid waste, and water and wastewater are accounted for in the community transportation, community solid waste, and potable water and wastewater treatment emissions totals, respectively. Appendix B provides detailed non-residential energy use data, emissions factors and calculation methods.

Table 5 and Table 6 illustrate the breakdown of the non-residential energy use and GHG emissions.

Table 5: 2005 Baseline and 2015 Non-Residential Energy Use Data

Non-Residential Energy Use	2005	2015	Percent Change
Electricity Use (kWh)	354,142,834	362,578,587	2%
Electricity T&D Losses (kWh)	19,950,392	18,241,271	-9%
Natural Gas Use (Therms)	11,222,889	7,399,702	-34%
Primary Boiler Propane Use (Gallons)	942,452	1,751,600	86%
Rio Bravo Power Station Woodwaste (Tons)	177,219	186,136	5%

Table 6: 2005 Baseline and 2015 Non-Residential Energy Use Emissions

Non-Residential Energy Use	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
Electricity Use	140,981	87,325	-38%
Electricity T&D Losses	7,004	5,297	-24%
Natural Gas Use	59,691	39,356	-34%
Total Non-Residential Energy Use	207,676	131,979	-36%
Information Items			
Primary Boiler Propane Use	5,322	9,892	86%
Rio Bravo Woodwaste (non-biogenic)	5,476	5,751	5%
Rio Bravo Woodwaste (Biogenic CO ₂)	255,664	268,528	5%

Community Transportation

Community Transportation, which includes on-road and off-road travel by people living in and visiting unincorporated Placer County, as well as other portable off-road equipment use, generated 513,019 metric tons of CO₂e in 2015. This is a 4% decrease in GHG emissions from the 535,222 metric tons of CO₂e in the 2005 inventory. This is primarily due to reduced on-road heavy-truck vehicle miles traveled (VMT) and reduced per-mile emissions due to more fuel-efficient vehicles, which offset increases in VMT for other vehicle types. Population in the unincorporated County increased 6.5% during this period and employment in the unincorporated County increase 19.4% during this period resulting in a decrease in a 4.6% decrease in VMT per service population (population and employment combined).

Note that electric vehicle miles tripled, and related emissions, while a minor information item, increased 67% between 2005 and 2015. These emissions are considered an information item since the electricity use and emissions are included in the Residential Energy Use and Non-Residential Energy Use Sectors. Electric vehicles are potentially zero-emission-transportation, depending on the source of their electricity.

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Annual VMT within the county was estimated by Fehr and Peers using Sacramento Area Council of Government's SACSIM model and Tahoe Regional Planning Agency's travel demand model outputs for Placer County reported in the Tahoe Regional Transportation Plan for 2005 and interpolated from other model years for 2015. Off-road vehicles and equipment use within the jurisdiction was estimated with California ARB's OFFROAD 2007, Pleasure Craft 2014, and Recreational Vehicles 2013 models. On-road transportation VMT increased 3% between 2005 and 2015. Off-road fuel use decreased 9%. Appendix C provides detailed community transportation data, emissions factors and calculation methods. Emissions from passenger rail and air travel by County community members were not included in the transportation sector analysis, as there are no rail stations or commercial air service within the unincorporated area. Table 7 and Table 8 illustrate the breakdown of community transportation GHG emissions.

Table 7: 2005 Baseline and 2015 Community Transportation Data

Community Transportation	2005	2015	Percent Change
On-Road Passenger Vehicles (miles)	421,396,875	463,721,782	10%
On-Road Light Duty Trucks and SUVs (miles)	422,329,534	427,119,534	1%
On-Road Heavy Duty Trucks (miles)	131,376,213	113,960,366	-13%
Total On-Road Miles	975,102,622	1,004,801,681	3%
Off-Road Vehicles and Equipment (gallons)	1,569,570	1,424,073	-9%
Information Items			
On-Road Electric Vehicles (miles)	1,166,247	3,487,700	199%

Table 8: 2005 Baseline and 2015 Community Transportation Emissions

Community Transportation	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
On-Road Passenger Vehicles	145,693	151,441	4%
On-Road Light Duty Trucks and SUVs	218,484	208,116	-5%
On-Road Heavy Duty Trucks	161,260	144,049	-11%
Off-Road Vehicles and Equipment	9,786	9,413	-4%
Total Community Transportation	535,222	513,019	-4%
Information Items			
On-Road Electric Vehicles	135	225	67%

Community Solid Waste

This inventory reports emissions from landfills and other solid waste sites located in the County during the inventory years (from waste deposited in past years), and the future emissions from solid waste generated by the community members in 2005 and 2015 - waste that will decompose over the next 100 years at the landfills. Solid waste emissions are caused by methane generated from the decomposition of organic wastes (e.g. paper, food scraps, wood.) in an oxygen-free environment, such as a landfill. Additionally, emissions from the collection and transportation of 2005 and 2015-

Placer County GHG Emissions Inventories

generated solid waste are provided as an Information Item, to provide additional context. They are not included in the solid waste emissions totals because of overlap with the community transportation emissions.

Unincorporated Placer County's community-generated solid waste resulted in 87,526 metric tons of CO₂e emissions in 2015. This is a 33% increase in GHG emissions from the 65,577 metric tons of CO₂e for 2005. This is the result of on-going waste deposition increasing in the total amount of waste landfilled at the Western Regional Landfill. There was a 4% decline in the annual reported volume of solid waste landfilled by the residents, businesses, and visitors of the unincorporated county. Many areas in California reported reduction in waste volumes between 2005 and 2015 due to increased recycling efforts and diversion requirements. There was also a 6.5% increase in population and a 19.4% increase in employment in unincorporated Placer County over this period resulting in an 11.3% decrease in solid waste landfilled per service population (population and employment combined). This decrease in waste deposited is partially due to Placer County's One Big Bin⁷ policy allows Placer County residents and visitors to easily and conveniently recycle anywhere and everywhere in the county by putting everything in one bin. This requires fewer trucks on the road to pick up the waste, reducing transportation emissions, and allows for recyclable materials to be removed at the Material Recovery Facilities.

Table 9 and Table 10 detail community solid waste emissions information. Appendix D provides detailed community solid waste data, emissions factors and calculation methods.

Table 9: 2005 Baseline and 2015 Community Solid Waste Data

Community Solid Waste	2005	2015	Percent Change
Community-Generated Solid Waste (Tons)	101,888	97,797	-4%
Solid Waste Disposal Sites (Tons Methane)	1,363	2,169	59%

Table 10: 2005 Baseline and 2015 Community Solid Waste Emissions

Community Solid Waste	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
Community-Generated Solid Waste	27,401	26,796	-2%
Solid Waste Disposal Sites	38,176	60,730	59%
Total Community Solid Waste	65,577	87,526	33%
Information Items			
Solid Waste Collection & Transportation	2,633	2,531	-4%

⁷ <http://onebigbin.com/>

Community Potable Water and Wastewater Treatment

This sector includes energy use and process and fugitive emissions from potable water service and wastewater treatment facilities serving the unincorporated Placer County area. Process emissions are released directly to the atmosphere from specific processes employed at a facility, for example methane produced at anaerobic lagoon systems or nitrous oxide emissions from nitrification and denitrification treatment activities. Fugitive emissions are unintentionally released, for example methane escaping from septic systems or nitrous oxide emissions produced by wastewater effluent discharged to the natural environment. Potable water includes the energy used for water extraction, conveyance, treatment, and distribution to County residents and community members. Wastewater treatment includes the energy used for collection, treatment, and disposal of community-generated wastewater, as well as the process and fugitive emissions associated with wastewater treatment in private septic systems and centralized facilities. Electricity used by potable water and wastewater infrastructure within the unincorporated County was subtracted from the non-residential electricity use to prevent double counting, and is reported here to provide context.

Potable water service energy use generated 2,202 metric tons of CO₂e in 2015, which was a severe drought year and therefore had a significant decrease in water use. This is a 58% decrease in GHG emissions from the 5,249 metric tons of CO₂e in the 2005 inventory, which was a wet year. There was a 12% increase in estimated population served during this period, as the area's population increased and existing residents switched from private wells to public water supplies. There was a 30% decrease in per-capita water use. Estimated energy intensity (kWh/gallon) decreased slightly by 6%. Estimated water use also decreased significantly from 13.6 to 10.6 million gallons per year between 2005 and 2015. Appendix E provides detailed community potable water activity data, emissions factors, and calculation methods.

Wastewater treatment energy use generated 2,009 metric tons of CO₂e in 2015. This is a 67% decrease in GHG emissions from the 6,009 metric tons of CO₂e calculated for 2005. This is due to a combination of reduced water use, including a 50% decrease in gallons used per-capita, and decreased utility per-kWh emissions factors. This was offset by a 6% increase in the estimated number of people served, and a 9% increase in electricity use per gallon (kWh/gallon treated). Electricity use decreased an estimated 28%.

Wastewater process and fugitive emissions were calculated using on-site data, population-based estimates and standard emissions factors for central plants, lagoons and septic systems. 7,337 metric tons of CO₂e were emitted in 2015, an 8% increase from the 6,775 metric tons of CO₂e reported for 2005. Appendix F provides details for wastewater treatment activity data, emissions factors, and calculation methods.

Table 11 and Table 12 detail potable water and wastewater treatment information and emissions

Table 11: 2005 Baseline and 2015 Community Potable Water and Wastewater Treatment Data

Community Potable Water and Wastewater Treatment	2005	2015	Percent Change
Electricity Use & T&D Losses - Potable Water Service (kWh)	12,186,454	8,851,552	-27%
Electricity Use & T&D Losses - Wastewater Treatment (kWh)	10,956,112	7,870,031	-28%
Central Plants (Population Served)	54,500	58,683	8%
Lagoons (Population Served)	1,083	1,069	-1%
Septic Systems (Population Served)	47,945	50,462	5%

Table 12: 2005 Baseline and 2015 Community Potable Water and Wastewater Treatment Emissions

Community Potable Water and Wastewater Treatment	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
Electricity Use & T&D Losses - Potable Water Service	5,249	2,202	-58%
Electricity Use & T&D Losses - Wastewater Treatment	6,009	2,009	-67%
Central Plants	704	998	42%
Lagoons	246	207	-16%
Septic Systems	5,825	6,131	5%
Total Potable Water and Wastewater Treatment	18,034	11,548	-36%

Agriculture, Livestock and Forest Management

This section includes emissions from agriculture equipment use, rice cultivation, fertilizer, lime, urea and pesticide use, enteric fermentation, manure management, crop residue burning, and forest biomass burning for fire prevention in unincorporated Placer County. Methane is emitted during rice cultivation when fields are flooded and organic material breaks down in an anaerobic environment. Additionally, methane is released by cattle, sheep, and swine during enteric fermentation when organic material is digested in their stomachs and by manure produced by cattle, sheep, swine, and chickens. Nitrous oxide is emitted when fertilizer is applied to crops. Finally, carbon dioxide is emitted when lime and urea are applied to crops, when fuel is combusted in agricultural equipment, and when crop residue and forest wood waste is burned. The CO₂ From crop residue and forest wood waste burning is considered biogenic though and is reported as an Information Item because the same CO₂ would be emitted if the organic material decomposed naturally.

Agricultural, livestock, and forest management activities generated 186,454 metric tons of CO₂e in 2015. This is a 31% decrease in GHG emissions from the 268,341 metric tons of CO₂e in 2005, primarily the result of a 33% reduction in acres used for rice cultivation and significant declines in the number of livestock.

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Table 13 and Table 14 detail agricultural, livestock and forest management information and emissions. Appendix G provides detailed activity data, emissions factors and calculation methods.

Table 13: 2005 Baseline and 2015 Agriculture, Livestock and Forest Management Data

Agriculture	2005	2015	Percent Change
Rice Cultivation (acres)	14,500	9,755	-33%
Other Crop Cultivation (acres)	18,027	14,668	-19%
Equipment Fuel Use (Gallons)	2,704,617	2,685,334	-1%
Residue Burning (acres)	2,893	803	-72%
Head of Chicken	5,566,331	1,000,000	-82%
Head of Other Livestock	23,860	19,991	-16%
Forest Area Treated (acres)	9,940	9,640	0%

Table 14: 2005 Baseline and 2015 Agriculture, Livestock and Forest Management Emissions

Agriculture	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
Rice Cultivation	201,029	135,244	-33%
Equipment Use	26,547	26,475	-0.3%
Other Agriculture & Livestock	38,304	22,273	-41%
Forest Management Open Burning (non-biogenic)	2,462	2,462	0%
Total Agriculture	268,341	186,454	-31%
Information Items			
Biogenic CO ₂ Residue Burning	9,037	2,434	-73%
Biogenic CO ₂ Wood waste Burning	20,442	20,442	0%

Placer County Community-Wide Emissions Efficiency Metrics

Community-wide efficiency metrics can be useful for measuring progress in reducing GHGs and for comparing one community's emissions with neighboring cities, counties, or regional and national averages.⁸ That said, due to differences in emissions inventory methods, it can be difficult to get directly comparable metrics, and one must be very careful when comparing figures. All efforts were made to estimate a community-wide emissions total and per capita emissions metric that will be comparable to other community inventories using the Significant Influence framework of the USCP.

Table 15 presents the baseline 2005 and 2015 community efficiency metrics calculated as part of this inventory. These metrics only include emissions directly tied to community-wide activities and sources: residential and non-residential energy use (including transmission and distribution losses from electricity use), on-road and off-road community transportation, community-generated solid waste, water and wastewater treatment energy use, agriculture, and process and fugitive emissions from solid waste facilities and wastewater treatment. Placer County's per-resident GHG emissions decreased 23% and per-service population GHG emissions decreased 24% from the 2005 baseline to 2015.

Table 15: 2005 Baseline and 2015 Community-Wide GHG Emissions Efficiency Metrics

Community-Wide Emissions Efficiency Metrics			
Inventory Year	2005	2015	Percent Change
Estimated Population	103,528	110,214	6.5%
Estimated Employment	16,790	20,041	19.4%
Estimated Service Population (population and employment)	120,318	130,255	8.3%
Community GHG Emissions (Metric Tons CO ₂ e)	1,440,913	1,181,915	-18%
GHG Emissions / Resident (Metric Tons CO ₂ e)	13.9	10.7	-23%
GHG Emissions / Service Population (Metric Tons CO ₂ e)	12.0	9.1	-24%

⁸ Per capita CO₂e emissions were 16.5 metric tons per year for the United States in 2014, and 11.3 metric tons per year for California in 2015.
https://www.arb.ca.gov/cc/inventory/data/graph/trends/ghg_trends_00-15.png,
<https://data.worldbank.org/indicator/EN.ATM.CO2E.PC?locations=US>

County-Operations Inventory Results

This section presents a detailed analysis of emissions resulting from the Placer County's operations. The county operations emissions are a subset of community-wide emissions⁹ and should not be added to community emissions totals since they are already included in the community-wide data. The county operations emissions included in this inventory were determined using the operational control framework, which includes emissions sources and activities for which the County has the full authority to introduce and implement operating policies. The county operations inventory also includes two additional emissions sectors for which the County has limited control: emissions from employee-generated solid waste and emissions from employees' personal commutes to work. Including these optional sources is recommended strongly by the LGOP even though the County does not have full operational control.

Emissions Summary

In 2015, County operations generated 49,388 metric tons of CO₂e for the sectors reported in this inventory. This is a 22% increase in GHG emissions from the 40,522 metric tons of CO₂e in the 2005 baseline inventory. This is primarily the result of increases in methane emissions from ongoing waste deposition at the Western Regional Landfill between 2005 and 2015. As shown, the Solid Waste sector is largest contributor of emissions within the county-operations inventory.

A 2005 baseline GHG Emissions Inventory was completed for Placer County in 2011. Since then, improved methodologies have become available. The improved methodologies were used to prepare the 2015 inventory and to update the original baseline 2005 results. Details on the updates to the baseline County operations inventory are explained in the Inventory Methodologies section. This section of the report compares 2015 GHG emissions to the updated 2005 baseline GHG emissions. In summary:

- Total County operations GHG emissions increased 22% (8,866 metric tons of CO₂e) from 2005 to 2015, primarily due to the ongoing landfilling of waste at the Western Regional Landfill between 2005 and 2015 resulting in a 61% increase in emissions in the Solid Waste Sector (an increase of 9,648 metric tons of CO₂e). These emissions are generated in the inventory year from waste deposited in the past.
- Over this time, the number of County employees decreased 5% from 2,461 to 2,349 employees.
- The buildings, facilities, and public lighting sector emissions decreased by 34 metric tons of CO₂e from 2005 to 2015, due in large part to lower electricity emissions factors, although electricity use increased slightly.

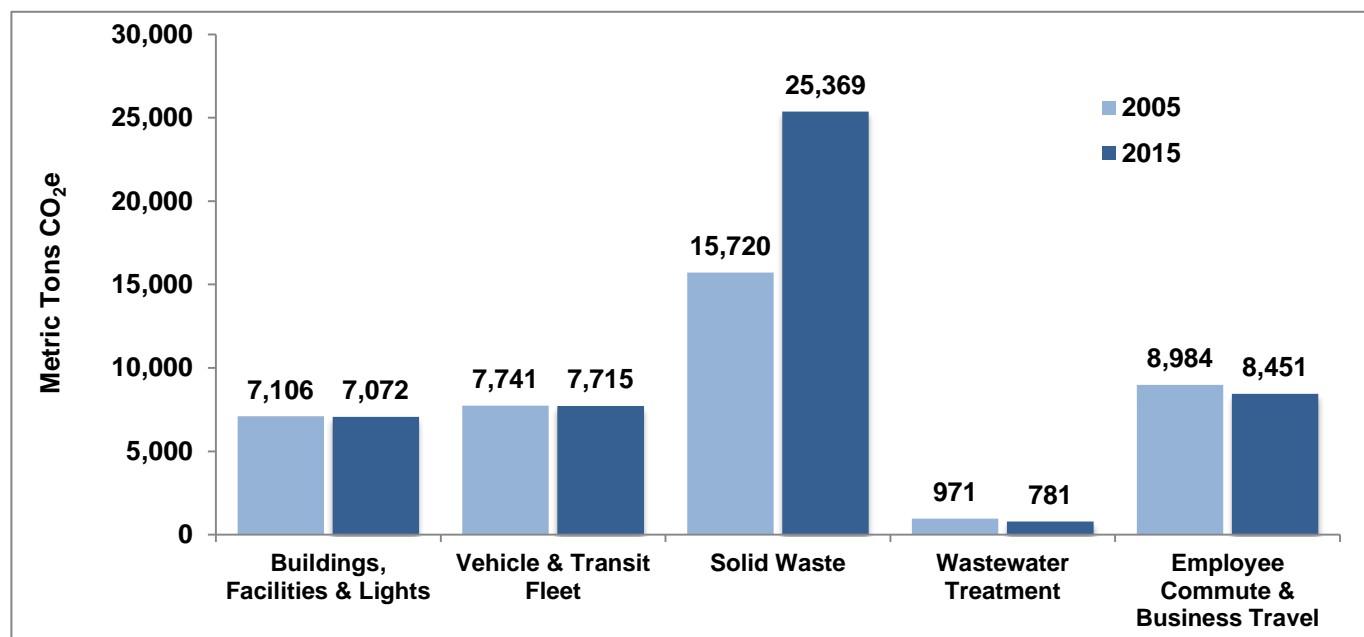
⁹ While the majority of county-operations emissions are a subset of the community-wide emissions, there are potentially emissions associated with County operations that occur in incorporated cities (e.g. Roseville), which are not included in the community-wide inventory.

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- Vehicle fleet emissions decreased by 721 metric tons of CO₂e from 2005 to 2015, although was offset by transit fleet emissions increasing by 695 metric tons of CO₂e.

Figure 2 compares 2015 GHG emissions to the 2005 Baseline GHG emissions for the County operations inventory.

Figure 2: 2005 Baseline and 2015 County-Operations GHG Emissions Summary



Buildings and Facilities

The buildings and facilities sector includes electricity, natural gas, and propane use at County owned and operated buildings and other facilities, as well as emissions from refrigerants leaking from air conditioning units. Electricity use is the source of the majority of GHG emissions reported for County buildings and facilities. While Placer County is a 50% owner of the Middle Fork Hydroelectric Project, the benefits from the hydropower production are incorporated into the utility emissions factors and reflected in the community-wide and county-operations electricity emissions. Emissions from this sector totaled 7,023 metric tons of CO₂e in 2015. This is a less than 0.3% decrease in GHG emissions from the 7,047 metric tons CO₂e in 2005. This occurred mostly because of reduced propane use and lower utility emissions factors. This reduction was largely offset by increases in electricity use, particularly from new facilities in Roseville, Lake Tahoe, and Rocklin. Public lighting owned by Placer County totaled an additional 49 metric tons of CO₂e estimated for 2015. This is a 17% decrease from the 59 metric tons of CO₂e estimated for 2005. Refer to Appendix H for detailed activity data, emissions factors and calculation methods used for the buildings and facilities sector. Table 16 and Table 17 presents the County operated buildings and facilities energy use and emissions. Table 18 & 19 presents the County operated public lighting energy use and emissions.

Table 16: 2005 Baseline and 2015 Buildings and Facilities Energy Use Data

Activity / Source	2005	2015	Percent Change
Electricity Use (kWh)	16,226,553	18,973,145	17%
Electricity T&D Losses (kWh)	914,112	954,536	4%
Natural Gas (Therms)	482,393	477,076	-1%
Propane Use (Gallons)	24,720	5,323	-78%

Table 17: 2005 Baseline and 2015 Buildings and Facilities Energy Use Emissions

Activity / Source	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
Electricity Use	4,026	4,192	4%
Electricity T&D Losses	304	254	-17%
Natural Gas Use	2,566	2,537	-1%
Propane Use	145	31	-79%
Refrigerant Leakage	7	9	29%
Buildings and Facilities Total	7,047	7,023	-0.3%
Information Items			
Ozone Depleting Refrigerant Leakage	463	662	43%

Table 18: 2005 Baseline and 2015 Public Lighting Energy Use Data

Activity / Source	2005	2015	Percent Change
County Owned Public Lighting Electricity Use (kWh)	241,035	194,918	-19%
County Owned Public Lighting Electricity T&D Losses (kWh)	13,579	9,806	-28%
PG&E Owned Public Lighting Electricity Use (kWh)	322,354	341,789	6%
PG&E Owned Public Lighting Electricity T&D Losses (kWh)	18,160	17,195	-5%

Table 19: 2005 Baseline and 2015 Public Lighting Energy Use Emissions

Activity / Source	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
County Owned Public Lighting Electricity Use	54	46	-16%
County Owned Public Lighting Electricity T&D Losses	4	3	-36%
Buildings and Facilities Total	59	49	-17%
Information Items			

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PG&E Owned Public Lighting Electricity Use	72	63	-12%
PG&E Owned Public Lighting Electricity T&D Losses	6	4	-26%

Vehicle and Transit Fleet

The vehicles and equipment used in the County's daily operations burn gasoline, diesel, propane, and compressed natural gas (CNG) fuel resulting in the emission of GHGs. In addition, vehicles with air conditioning use refrigerants that can leak from the vehicles during normal operation and maintenance, and these refrigerants are often GHGs. In 2015, the County operated a fleet with 812 vehicles including vehicles for Sheriff, Public Works, and a number of other departments. Placer County's 2015 vehicle fleet emissions are 5,455 metric tons of CO₂e. This is a 12% decrease in GHG emissions from the 6,176 metric tons of CO₂e in the 2005 inventory. This is primarily the result of a decrease in on-road vehicle miles traveled, reduced propane use, and an increase in fuel efficiency between inventory years. The transit fleet emissions are an additional 2,260 metric tons of CO₂e in 2015. This is a 44% increase in emissions from the 1,565 metric tons of CO₂e in 2005. This is primarily the result of increases in transit fleet miles traveled, and increases in fuel use due to the increased miles traveled and larger buses in use in 2015 that are slightly less efficient on a miles per gallon basis. Refer to Appendix I for detailed activity data, emissions factors and calculation methods. Table 20 and Table 21 present the vehicle fleet activity data and emissions. Table 22 and 23 presents the transit fleet activity data and emissions.

Table 20: 2005 Baseline and 2015 Vehicle Fleet Data

Source	2005	2015	Percent Change
On-Road Gasoline Fuel Use (Gallons)	564,327	448,445	-21%
On-Road Diesel Fuel Use (Gallons)	35,190	70,390	100%
On-Road CNG Fuel Use (Therms)	5,136	9,813	91%
Off-Road Gasoline Fuel Use (Gallons)	7,538	2,145	-72%
Off-Road Diesel Fuel Use (Gallons)	27,250	33,389	23%
Off-Road Propane Fuel Use (Gallons)	12,840	0	-100%
On-Road Vehicle Miles Traveled (Miles)	7,615,577	6,563,655	-14%
Vehicles in Operation	755	812	8%

Table 21: 2005 Baseline and 2015 Vehicle Fleet Emissions

Source	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
On-Road Fuel Use	5,446	4,763	-13%
Off-Road Fuel Use	424	363	-14%
Leaked Refrigerants	307	330	8%
Vehicle Fleet Total	6,176	5,455	-12%

Table 22: 2005 Baseline and 2015 Transit Fleet Data

Source	2005	2015	Percent Change
On-Road Diesel Fuel Use (Gallons)	32,275	51,630	60%
On-Road CNG Fuel Use (Therms)	213,704	301,590	41%
On-Road Vehicle Miles Traveled (Miles)	991,855	1,263,535	27%

Table 23: 2005 Baseline and 2015 Transit Fleet Emissions

Source	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
On-Road Fuel Use	1,565	2,260	44%
Transit Fleet Total	1,565	2,260	44%

County-Generated Solid Waste and County-Operated Solid Waste Facilities

County operations generate solid waste during normal activity, much of which is eventually landfilled. Emissions from County operations generated solid waste are estimates of methane generation that will result from decomposing waste that was sent to the landfill in the inventory year. Community-generated waste collected by the County (e.g. park trash cans) is excluded from this sector's totals and reported as an Information Item because the County provides this waste collection as a public service and has little control over the waste that is deposited. It is important to note that although these emissions are attributed to the inventory year in which the waste is generated, the emissions themselves will occur over the 100+ year timeframe during which the waste decomposes.

Government-operated solid waste facilities generate emissions from decomposing waste as well as from electricity and other fuels used in the operations. This inventory includes 42% of the emissions from Western Regional MRF/Landfill (based on JPA agreement) and 62% of emissions from Eastern Regional MRF/Landfill (based on current percent of waste volumes from unincorporated Placer County), as well as emissions from other minor closed facilities including Looms, Meadow Vista and Foresthill. These are emissions generated in the inventory year from waste deposited in the past.

Placer County's 2015 Solid Waste Sector emissions are 25,369 metric tons of CO₂e. This is a 61% increase in emissions from the 15,720 metric tons of CO₂e in 2005, corresponding to continued deposition of waste at Western Regional Landfill between 2005 and 2015. County operations saw a slight reduction in emissions due to changes in waste composition. Refer to Appendix J for detailed activity data, emissions factors and calculation methods used in the government-generated solid waste sector. Table 24 and Table 25 present the County's solid waste activity data and emissions.

Table 24: 2005 Baseline and 2015 Solid Waste Data

Activity / Source	2005	2015	Percent Change
County-Generated Solid Waste (Tons)	791	800	1%
Landfill and MRF Facility Electricity Use & T&D Losses (kWh)	1,104,841	1,382,350	25%
Landfill and MRF Facility Propane Use (Gallons)	52,252	52,252	0%
Landfill and MRF Facility Diesel Use (Gallons)	3,638	5,671	56%
Western Regional Landfill - 42% Allocation (Metric Tons CH ₄)	451	837	85%
Eastern Regional Closed Landfill - 46.5% Allocation (Metric Tons CH ₄)	44	24	-46%
Other Closed Landfills (Metric Tons CH ₄)	27	11	-59%
Information Items			
Community-Generated Solid Waste (Tons)	110	108	-2%

Table 25: 2005 Baseline and 2015 Solid Waste Emissions

Activity / Source	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
County-Generated Solid Waste	288	269	-7%
Solid Waste MRF and Landfills – Electricity & T&D Losses	470	337	-28%
Solid Waste MRF and Landfills – Propane Use	306	306	0%
Solid Waste MRF and Landfills – Diesel Use	37	58	56%
Western Regional Landfill	12,630	23,426	85%
Eastern Regional Landfill	1,226	664	-46%
Other Landfills	763	309	-59%
Solid Waste Total	15,720	25,369	61%
Information Items			
Community-Generated Solid Waste	30	30	-1%

County-Operated Wastewater Treatment Facilities

The wastewater treatment sector includes the emissions generated by the wastewater systems operated by Placer County. Facilities include Sewer Maintenance District (SMD) #1, SMD#3, and several small lagoon and septic systems. The wastewater treatment facilities generated 781 metric tons of CO₂e in 2015. This is a 20% decrease in GHG emissions from the 971 metric tons of CO₂e in 2005. This is primarily the result of reduced propane use and utility electricity emissions factors. Table 26 and Table 27 details the wastewater treatment activity data and emissions. Appendix K provides detailed wastewater activity data, operating processes, emissions factors and calculation methods.

Table 26: 2005 Baseline and 2015 Wastewater Treatment Data

Activity / Source	2005	2015	Percent Change
County-Operated Wastewater Facility Electricity Use and T&D Losses (kWh)	1,743,804	1,714,294	-2%
County-Operated Wastewater Facility Propane Fuel Use (gallons)	24,314	3,723	-85%
County-Operated Wastewater Facility Wastewater Treated (Million Gallons)	774	462	-40%
County-Operated Wastewater Facility Population Served	15,670	16,305	4%

Table 27: 2005 Baseline and 2015 Wastewater Treatment Emissions

Activity / Source	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
County-Operated Wastewater Facility Electricity Use and T&D Losses	399	322	-19%
County-Operated Wastewater Facility Propane Fuel Use	142	22	-85%
County-Operated Wastewater Facility Wastewater Process Emissions	430	437	2%
Total Wastewater Emissions	971	781	-20%

Employee Commute and Business Travel

Although employees' personal commute is not under the direct operational control of the County, there are a variety of tools and resources available to influence employees' commute patterns. For this reason emissions are included in this inventory. County employee's commute to work generated 6,902 metric tons of CO₂e in 2015. This is a 5% decrease in GHG emissions from the 7,261 metric tons of CO₂e estimated for 2005. A survey was administered to 709 employees in 2010 to collect the data for 2005, and to 643 employees in 2017 for 2015. The results were extrapolated using the number of employees in each inventory year. There was a 5% decrease in the number of employees from 2,461 to 2,349 between 2005 and 2015. Business travel was included in the 2017 survey, and results extrapolated to the two inventory years. Travel via personal vehicles, transit and air generated 1,549 metric tons of CO₂e in 2015. This is a 10% decrease in GHG emissions from the 1,723 metric tons CO₂e reported for 2005. This is due to a decrease in number of employees and an increase in estimated vehicle efficiency. Refer to Appendix L for detailed activity data, emissions factors and calculation methods for the employee commute and business travel. Table 28 and Table 29 present the activity data and emissions from the Employee Commute and Business Travel Sector.

Table 28: 2005 Baseline and 2015 Employee Commute and Business Travel Data

Activity / Source	2005	2015	Percent Change
Employee Commute (Gallons)	809,224	774,085	-4%
Employee Commute (Miles)	17,872,337	17,956,912	0.5%
Business Travel Personal Vehicles (Miles)	3,464,236	3,306,578	-5%
Business Travel Transit Bus (Miles)	18,697	17,846	-5%
Business Travel Air (miles)	1,003,908	958,220	-5%
Number of Employees	2,461	2,349	-5%
Information Items			
Business Travel County Vehicles (Miles)	2,278,504	2,174,809	-5%

Table 29: 2005 Baseline and 2015 Employee Commute and Business Travel Emissions

Activity / Source	2005 Metric Tons CO ₂ e	2015 Metric Tons CO ₂ e	Percent Change
Employee Commute	7,261	6,902	-5%
Business Travel	1,723	1,549	-10%
Employee Commute & Business Travel Total	8,984	8,451	-6%
Information Items			
Business Travel County Vehicle	1,023	914	-11%

Conclusion & Next Steps

The data presented in this report is intended to provide valuable information that the County can use to inform future planning efforts, identify cost saving opportunities and identify planning priorities. This analysis found that in 2015, the community as a whole was responsible for emitting 1,181,915 metric tons of CO₂e, a decrease of 18% since the 2005 baseline. Placer County's County operations emitted 49,388 metric tons of CO₂e, an increase of 22% since the 2005 baseline. County staff should continue to update these inventories every five years to monitor progress. Additional key findings from this analysis include:

- The largest source of community-wide GHG emissions in 2015 is from community transportation (513,019 metric tons of CO₂e). Substantial emissions also originate from residential energy use (251,389 metric tons of CO₂e) and community agriculture, livestock and forest management (186,454 metric tons of CO₂e).
- Emissions from every community-wide sector except for solid waste decreased between 2005 and 2015. The greatest reduction in the amount of emissions occurred in the residential energy use sector (decrease of 94,674 metric tons of CO₂e), followed by Agriculture (81,887 metric tons of CO₂e) and non-residential energy use (75,697 metric tons of CO₂e).
- The largest source of county operations GHG emissions in 2015 is the solid waste sector (25,369 metric tons of CO₂e). Significant emissions also originate from employee commute and business travel (8,451 metric tons of CO₂e), vehicle and transit fleet (7,715 metric tons of CO₂e), and buildings, facilities, and public lighting (7,072 metric tons of CO₂e).
- The largest change in county operations GHG emissions between 2005 and 2015 was from increased emissions in the solid waste sector, due to ongoing deposition of waste at the Western Regional Landfill between 2005 and 2015. There were substantive declines in employee commute and business travel emissions, buildings, facilities, and public lighting and vehicle fleet emissions.

As the County moves forward with the development of emissions reduction strategies in the Placer County Sustainability Plan, the County should prioritize strategies including: energy conservation, renewable energy, vehicle fuel type and efficiency improvements, alternative transportation, vehicle trip reduction, land use and transit planning, waste reduction, and others that can achieve benefits beyond reducing emissions, including saving money, improving the County's economic vitality, and ultimately increasing the quality of life for its residents, businesses, and visitors.

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Appendix A – Residential Energy Use Sector Notes

Table A-1: Residential Energy Use Data

Activity / Source	2005	2015	Units	Data Source
PG&E Electricity	404,183,209	362,566,198	kWh	Pacific Gas and Electric (PG&E)
SMUD Electricity	16,776,047	24,467,193	kWh	Sacramento Municipal Utility District (SMUD)
NV Energy / Liberty Utilities Electricity	98,776,890	88,877,030	kWh	NV Energy (2005) / Liberty Utilities (2015)
Direct Access Electricity (non-utility provider)	533	Included in PG&E Non-Res DA	kWh	California Energy Commission (CEC) and PG&E
Electricity Transmission & Distribution (T&D) Losses	29,279,006	23,942,978	kWh	U.S. Environmental Protection Agency eGRID
T&D Grid Loss Factor	5.333%	4.790%	%	
Total Electricity	549,015,685	499,853,399	kWh	
PG&E Natural Gas	9,127,471	8,442,818	Therms	Pacific Gas and Electric (PG&E)
Southwest Gas Natural Gas	9,306,735	8,819,537	Therms	Southwest Gas
Total Natural Gas	18,434,206	17,262,355	Therms	
Propane (LPG)	8,545,439	5,743,410	Gallons	U.S. Environmental Protection Agency, Energy Information Administration, and U.S. Census Bureau
Fuel Oil / Kerosene	177,070	65,983	Gallons	
Wood	503,156	806,994	MMBtu	

Methods:

Utility-Derived Data

Utility-provided activity data is shown in Table A-1. Electricity consumption and natural gas data was collected from NV Energy/Liberty Utilities, Pacific Gas and Electric Company (PG&E), Sacramento Municipal Utility District (SMUD), and Southwest Gas for all facilities within unincorporated Placer County. The data was categorized as residential or non-residential. The residential data was entered into ClearPath where the GHG emissions were calculated using utility-reported and calculated grid emissions factors for electricity. The calculation methods and emissions factors are shown in Table A-2.

Table A-2: Residential GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂ lbs/MWh	CH ₄ lbs/GWh	N ₂ O lbs/GWh	Emissions Factor Source
2005 Electricity – PG&E	BE.2.2	489.16	30.24	8.08	2005 PG&E (CO ₂) & 2005 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – NV Energy	BE.2.2	1,900.37	19.13	14.9	2005 Sierra Pacific Power Company (CO ₂) & 2005 U.S. EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2005 Electricity – SMUD	BE.2.2	616.07	30.24	8.08	2005 SMUD (CO ₂), 2005 EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – Direct Access and T&D Losses Western County	BE.2.2	724.12	30.24	8.08	2005 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ , N ₂ O)
2005 Electricity – T&D Losses Eastern County	BE.2.2	902.24	19.13	14.9	2005 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – PG&E	BE.2.2	404.51	33.1	4.0	2015 PG&E (CO ₂) & 2014 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2015 Electricity – Liberty Utilities	BE.2.2	936.97	97.8	14.2	2015 Liberty Utilities (CO ₂) & 2014 EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2015 – SMUD	BE.2.2	590.84	33.1	4.0	2015 SMUD (CO ₂), 2014 EPA eGRID WECC California (CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Western County	BE.4.1	568.6	33.1	4.0	2014 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Eastern County	BE.4.1	907.0	97.8	14.2	2014 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
Activity / Source	Method	CO ₂	CH ₄	N ₂ O	Emissions Factor Source
Natural Gas	BE.1.1	53.02 kg/MMBtu	0.005 kg/MMBtu	0.0001 kg/MMBtu	USCP Appendix C - Table B.1 and Table B.3
LPG	BE.1.2	5.79 kg/Gallon	0.001 kg/Gallon	0.0001 kg/Gallon	USCP Appendix C - Table B.1 LPG and Table B.4 Residential LPG
Fuel Oil/Kerosene	BE.1.2	10.15 kg/Gallon	0.0015 kg/Gallon	0.0001 kg/Gallon	USCP Appendix C - Table B.1 Kerosene and Table B.4 Residential Kerosene
Wood	BE.1.2	93.80 kg/MMBtu	0.316 kg/MMBtu	0.0042 kg/MMBtu	USCP Appendix C - Table B.2 Wood and Wood Residuals and Table B.3 Biomass Fuels Solid Residential

Table A-3: 2005 Residential Non-Utility Home Heating Fuel Use Calculations

Fuel Type	Propane	Fuel Oil / Kerosene	Wood	Data Source
California Fuel Use	7,365	460	1,294	Energy Information Administration (EIA) State Energy Data System (SEDS) 2005 California Residential Energy Use Estimates
Units	Thousand Barrels	Thousand Barrels	Thousand Cords	
# of California Households	415,918	48,008	217,623	U.S. Census Bureau, 2005 American Community Survey (ACS) 1-year estimates Table B25040. California Households using non-utility fuels for home heating
Per Household Fuel Use	743.7	402.4	118.9	
Units	Gallons	Gallons	MMBtu	U.S. Census Bureau, 2005 American Community Survey (ACS) 5-year estimates (2005-2009). Table DP04/B25040. Community households using non-utility fuels for home heating
Households in Unincorporated Placer County using non-utility heating fuels:	11,490	440	4,231	

Table A-4: 2015 Residential Non-Utility Home Heating Fuel Use Calculations

Fuel Type	Propane	Fuel Oil / Kerosene	Wood	Data Source
California Fuel Use	5,200	121	1,627	Energy Information Administration (EIA) State Energy Data System (SEDS) 2015 California Residential Energy Use Estimates
Units	Thousand Barrels	Thousand Barrels	Thousand Cords	
# of California Households	399,275	30,962	218,185	U.S. Census Bureau, 2015 American Community Survey (ACS) 1-year estimates Table B25040. California Households using Non-Utility Fuels for Home Heating
Per Household Fuel Use	547.0	164.1	149.1	
Units	Gallons	Gallons	MMBtu	U.S. Census Bureau, 2011-2015 American Community Survey (ACS) 5-year estimates. Table DP04.
Households in Unincorporated Placer County using non-utility heating fuels:	10,500	402	5,411	

Non-Utility Derived Data

Non-utility activity data is shown in Table A-1. Propane (LPG), fuel oil/kerosene and wood used for home heating were estimated using Energy Information Administration (EIA) and U.S. Census Bureau American Community Survey (ACS) data. The EIA State Energy Data System California residential energy use estimates and the U.S. Census Bureau ACS 1-year estimates of California households using non-utility fuels for home heating was used to calculate California per household fuel use. This per household fuel use factor was applied to the number of households using non-utility fuels for home heating in unincorporated Placer County. The number of households was estimated using the U.S. Census Bureau ACS 5-year estimates (2005-2009 and 2011-2015) of unincorporated Placer County's occupied households using propane, fuel oil/kerosene, and wood for home heating.

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Table 1 shows the activity data for home heating use. Tables A-3 and Table A-4 above show the data used for the, propane (LPG) fuel oil/kerosene and wood calculations for 2005 and 2015. Activity data was then entered into ClearPath using the calculation methods and emissions factors shown in Table A-2.

Direct Access Electricity Data

Direct access activity data is shown in Table A-1. Direct access electricity is supplied by an energy service provider other than a utility, but uses a utility's transmission lines to distribute the energy. In 2005, direct access electricity use was estimated for unincorporated Placer County based on the ratio of direct access to utility provided electricity for Placer County. In 2015, direct access electricity use was provided by PG&E. The direct access totals for unincorporated Placer County were entered into ClearPath where the GHG emissions were calculated using the EPA eGRID WECC California grid average emissions factors.

Electricity Transmission and Distribution (T&D) Losses Data

Electricity transmission and distribution (T&D) losses activity data is shown in Table A-1. T&D losses were calculated for residential electricity using EPA eGRID region grid gross loss (ggl) factors following EPA guidance shown in Table A-2. EPA recommends multiplying electricity consumption by $ggl/(1-ggl)$. The calculated T&D losses were entered into ClearPath where the GHG emissions were calculated using the EPA eGRID WECC California and Northwest sub-regions grid-average emissions factors.

Appendix B – Non-Residential Energy Use Sector Notes

Table B-1: Non-Residential Energy Use Data

Activity / Source	2005	2015	Units	Data Source
PG&E - excluding water and wastewater	229,609,395	256,660,420	kWh	PG&E
SMUD Electricity	14,024,443	14,470,915	kWh	SMUD
NV Energy / Liberty Utilities Electricity - excluding water and wastewater	92,357,865	73,558,598	kWh	NV Energy (2005) / Liberty Utilities (2015)
Direct Access Electricity	18,151,131	17,888,654	kWh	CEC and PG&E
Electricity Transmission & Distribution (T&D) Losses	19,950,392	18,241,271	kWh	U.S. EPA
T&D Grid Loss Factor	5.33	4.79	%	U.S. EPA
Total Electricity and T&D Losses	374,093,226	380,819,858	kWh	
PG&E Natural Gas	8,857,399	3,973,307	Therms	PG&E
Southwest Gas Natural Gas	2,365,490	3,426,395	Therms	Southwest Gas
Total Natural Gas	11,222,889	7,399,702	Therms	
Propane ("Primary" Boilers)	942,452	1,751,600	Gallons	Placer County Air Pollution Control District
Rio Bravo Power Station Woodwaste	177,219	186,136	Tons	

Methods:

Utility-Derived Data

Utility-provided activity data is shown in Table B-1. Electricity and natural gas use data was collected from Sacramento Municipal Utilities District (SMUD), NV Energy/Liberty Utilities, Pacific Gas and Electric Company (PG&E), and Southwest Gas for all facilities within unincorporated Placer County. The utility data provided was categorized as residential or non-residential. Activity data, shown in Table B-1, was entered into ClearPath where the GHG emissions were calculated using utility and EPA reported grid emissions factors. The calculation methods and emissions factors are shown in Table B-2.

Table B-2: Non-Residential GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂ lbs/MWh	CH ₄ lbs/GWh	N ₂ O lbs/GWh	Emissions Factor Source
2005 Electricity – PG&E	BE.2.2	489.16	30.24	8.08	2005 PG&E (CO ₂) & 2005 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – NV Energy	BE.2.2	1,900.37	19.13	14.9	2005 Sierra Pacific Power Company (CO ₂) & 2005 U.S. EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2005 Electricity – SMUD	BE.2.2	616.07	30.24	8.08	2005 SMUD (CO ₂), 2005 EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – Direct Access and T&D Losses Western County	BE.2.2	724.12	30.24	8.08	2005 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ , N ₂ O)
2005 Electricity – T&D Losses Eastern County	BE.2.2	902.24	19.13	14.9	2005 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – PG&E	BE.2.2	404.51	33.1	4.0	2015 PG&E (CO ₂) & 2014 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2015 Electricity – Liberty Utilities	BE.2.2	936.97	97.8	14.2	2015 Liberty Utilities (CO ₂) & 2014 EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2015 – SMUD	BE.2.2	590.84	33.1	4.0	2015 SMUD (CO ₂), 2014 EPA eGRID WECC California (CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Western County	BE.4.1	568.6	33.1	4.0	2014 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Eastern County	BE.4.1	907.0	97.8	14.2	2014 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
Activity / Source	Method	CO ₂	CH ₄	N ₂ O	Emissions Factor Source
Natural Gas	BE.1.1	53.02 kg/MMBtu	0.005 kg/MMBtu	0.0001 kg/MMBtu	USCP Appendix C - Table B.1 and Table B.3
Propane (LPG)	BE.1.2	5.59 kg/Gallon	0.001 kg/Gallon	0.0001 kg/Gallon	USCP Appendix C - Table B.1 LPG and Table B.4 Non-Residential LPG
Wood and Wood Residuals	BE.1.2	1442.64 kg/short ton	0.0093 kg/MMBtu	0.0059 kg/MMBtu	USCP Appendix C - Table B.2 Wood and Wood Residuals and Table B.5 Biomass Fuels Wood/Wood Waste Boilers

Non-Utility Derived Data

Propane and woodwaste use activity data are shown in Table B-1. Propane use data for “primary boilers” and woodwaste data for the Rio Bravo Power Plant were provided by the Placer County Air Pollution Control District. Activity data, shown in Table B-1, was entered into ClearPath where the GHG emissions were calculated using standard emissions factors. The calculation methods and emissions factors are shown in Table B-2.

Direct Access Electricity Data

Direct access activity data is shown in Table B-1. Direct access electricity is supplied by an energy service provider other than a utility, but uses a utility's transmission lines to distribute the energy. In 2005, direct access electricity use was estimated for unincorporated Placer County based on the ratio of direct access to utility provided electricity for Placer County. In 2015, direct access electricity use was provided by PG&E. The direct access totals for unincorporated Placer County were entered into ClearPath where the GHG emissions were calculated using the EPA eGRID WECC California grid average emissions factors.

Electricity Transmission and Distribution (T&D) Losses Data

Electricity transmission and distribution (T&D) losses activity data is shown in Table B-1. T&D losses were calculated for the combined electricity total, utility and direct access electricity combined, using EPA eGRID region grid gross loss (ggl) factors following EPA guidance and shown in Table B-2. EPA recommends multiplying electricity consumption by $\text{ggl}/(1-\text{ggl})$. The calculated T&D losses were entered into ClearPath where the GHG emissions were calculated using the EPA eGRID WECC California and Northwest sub-regions grid average emissions factors.

Appendix C – Community Transportation Sector Notes

Table C-1: Community Transportation Data

Activity / Source (On-Road)	Vehicle Miles Traveled (VMT)		Fuel Use (Gallons or kWh)		Data Source
	2005	2015	2005	2015	
Passenger Cars – Gasoline	419,688,209	459,647,639	16,956,204	17,620,079	VMT: Fehr and Peers Fuel Use: California ARB EMFAC 2014 model
Passenger Cars - Diesel	1,708,666	4,074,143	57,098	121,574	
Light Trucks and SUVs - Gasoline	421,994,875	425,109,804	25,329,843	24,269,640	
Light Truck and SUVs - Diesel	334,659	2,009,729	17,212	95,294	
Heavy Trucks - Gasoline	37,180,395	24,357,529	4,310,110	2,894,661	
Heavy Trucks - Diesel	94,195,817	89,602,837	12,193,249	11,735,166	
Passenger Cars - Electric	1,095,781	3,453,222	383,523	1,208,628	
Light Trucks and SUVs - Electric	70,467	34,479	24,663	12,068	
Activity / Source	2005		2015		Data Source
Total Annual VMT	976,268,869		1,008,289,382		Fehr and Peers
Activity / Source (Off-Road)		2005	2015	Data Source	
Off-road Vehicles and Equipment	CO ₂ (Metric Tons)	9,734.26	9,374.43	California ARB OFFROAD 2007, PC 2014, & RV 2013 models	
	N ₂ O (Metric Tons)	0.13	0.11		
	CH ₄ (Metric Tons)	0.65	0.37		

Table C-2: Community Transportation GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O	Emissions Factor Source
Placer County		2005 (grams/mile)			2015 (grams/mile)			California ARB EMFAC 2014 County Emissions Inventory Model
Passenger Cars - Gasoline	TR.1.B	339.84	0.042227	0.017880	322.90	0.018309	0.012712	
Passenger Cars - Diesel	TR.1.B	336.83	0.010771	0.011081	300.79	0.002048	0.009895	
Light Trucks and SUVs – Gasoline	TR.1.B	507.92	0.047611	0.030460	481.69	0.020472	0.018931	
Light Trucks and SUVs - Diesel	TR.1.B	518.43	0.013428	0.017055	477.95	0.001219	0.015723	
Heavy Trucks - Gasoline	TR.1.B	973.03	0.171212	0.081697	998.59	0.093071	0.039408	

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Heavy Trucks - Diesel	TR.1.B	1304.79	0.046187	0.042924	1320.14	0.035400	0.043429	
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Methods:

On-Road Vehicles

On-road transportation emissions for unincorporated Placer County are calculated using vehicle miles traveled (VMT) estimated by Fehr and Peers using the SACOG SACSIM model and the TRPA Regional Transportation Plan reported VMT, coupled with county-level emissions factors from the California Air Resources (ARB) Emissions Factors (EMFAC) 2014 model for 2005 and 2015. On-road transportation activity data is shown in Table C-1. Activity data was entered into ClearPath where county-level fuel and vehicle-specific emissions factors, shown in Table C-2, were applied to calculate the GHG emissions associated with community on-road transportation. The methodology for collecting and conditioning this data is as follows:

Fuel / Vehicle Type Breakdown and Emissions Calculations

VMT and emissions percentages by fuel and vehicle type are estimated for the total county using the California ARB's EMFAC 2014 model. The EMFAC 2014 model was run for 2005 and 2015 for Placer County. Data from this model was used to derive county-specific per-mile emissions factors and vehicle fuel efficiencies for gas, diesel and electric fuels for passenger cars, light-duty trucks / SUVs and heavy-duty trucks, as well as the percent of VMT attributed to each of the vehicle classifications. These were applied to the VMT estimates to derive emissions by fuel and vehicle class.

EMFAC 2014 reports CO₂, CH₄ and N₂O emissions factors for 51 different vehicle type and fuel combinations for every county in California, informed by California Department of Motor Vehicles registrations, the Smog Check program and many other data sources. Average CO₂ emissions factors were calculated for gasoline and diesel passenger vehicles, light trucks and heavy trucks. The local vehicle and fuel specific average CH₄ and N₂O emissions factors were calculated from EMFAC2014. The CH₄ emissions for all vehicles were calculated from County EMFAC 2014 reported methane total exhaust (CH₄_Totex). N₂O emissions for gasoline-fueled vehicles were calculated from County EMFAC 2014 reported nitrogen oxides total exhaust (NO_x_Totex) multiplied by 0.0416, the average fraction of NO_x emissions that are, or react into, N₂O, based on guidance from ARB. N₂O emissions for diesel fueled vehicles were calculated from County EMFAC 2014 reported Fuel Use multiplied by 0.3316 grams per gallon, based on guidance from ARB.

Off-Road Emissions

Off-road emissions were estimated with standard procedures using California ARB's OFFROAD 2007 model for most equipment/vehicle types, PC 2014 for Pleasure Craft, and RV 2013 for Recreational Vehicles. The models estimate emissions for various off-road, fuel-consuming machines at the county level. Only machine types that are thought to have significant operation within the county limits of unincorporated Placer County are considered. These are delineated in

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Table D-3 along with the methods used to allocate emissions to the unincorporated portion of the County. The off-road emissions data from OFFROAD 2007 should be considered a rough estimate.

The data produced by the models is daily usage – the final data was multiplied by 365.25 in order to produce annual emissions. The final data was entered into ClearPath as annual emissions of CO₂, CH₄, and N₂O, in metric tons.

Table C-3: Community Off-Road Categories and Proportion of County Total

Equipment Category	Allocation Method	2005 Ratio	2015 Ratio
Construction and Mining	Residential Building Permits	21%	22%
Entertainment	Population	34%	30%
Industrial	Jobs	15%	16%
Lawn and Garden	Occupied Households	33%	30%
Light Commercial	Jobs	15%	16%
Logging	100%	100%	100%
Other Portable	Population	34%	30%
Pleasure Craft	100%	100%	100%
Railyard Operations	Exclude – Railyards in cities	0%	0%
Recreational Vehicles	Population	34%	30%
Transport Refrigeration Units	Exclude - Pass through	0%	0%

Appendix D – Community Solid Waste Sector Notes

Table D-1: Community Solid Waste Data

Landfill	2005 Tons Waste Deposited	2015 Tons Waste Deposited	Landfill Gas Capture?	Distance to Facility (Miles)	Transport Fuel	Data Source
In-state Disposal (94+% to Western Regional)	75,585	65,352	Yes	35	Assume Diesel	CalRecycle Disposal Reporting System. Landfill gas capture data from facilities. Distance estimated using Google maps.
Alternative Daily Cover (ADC) (most to Western)	3,488	9,509	Yes	35	Assume Diesel	
Out-of-State export (Lockwood)	22,815	22,936	Installed in 2009	65	Assume Diesel	

Table D-2: Community Solid Waste GHG Calculation Methods and Emissions Factors

Activity / Source	Method	Type	Emissions Factor			Emissions Factor Source
Collection and Transportation of Solid Waste	SW.6	Solid Waste Collection	0.020 Metric Tons CO ₂ e / wet short ton			USCP Appendix E (page 29)
		Solid Waste Transportation	0.00014 Metric Tons CO ₂ e / wet short ton / mile			USCP Appendix E (page 29)
Activity / Source	Method	Type	2004 % by Weight for 2005	2015 % by Weight	EF (metric tons CH ₄ / wet short ton)	Percentages and Emissions Factor Source
Community-Generated Statewide Waste Characterization	12.2.2	Newspaper	3.2	1.2	0.043	CalRecycle California Statewide Waste Characterization Study (Proxy year 2004 for 2005) CalRecycle 2015
		Office Paper	5.5	4.6	0.203	
		Corrugated Cardboard	5.7	3.3	0.120	
		Magazines/Third Class Mail	6.7	8.1	0.049	
		Food Scraps	14.6	18.7	0.078	
		Grass	2.1	1.1	0.038	
		Leaves	2.1	2.7	0.013	
		Branches	2.6	4.8	0.062	USCP Appendix E (Page 34) & U.S. EPA Waste Reduction Model (WARM)
		Dimensional Lumber	9.6	11.9	0.062	
		All other (Non-Organic)	47.9	43.6	0	

Methods:

Community-Generated Solid Waste

Solid waste generated within the county in the inventory years and disposed of in the landfills listed above generates GHG emissions that need to be included in an inventory. Reportable emissions occur at the landfills over the entire period that waste decomposes, estimated to be 100 years. The tonnage of landfilled waste generated by unincorporated Placer County

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residents, businesses, and visitors was collected from the California Integrated Waste Management Board (CIWMB) Disposal Reporting System. The CIWMB was replaced by the California Department of Resources Recycling and Recovery (CalRecycle). Waste characterization percentages from CalRecycle, shown in Table D-2, were applied to the tonnage of community-generated waste that was landfilled. The waste tonnage and characterization data were entered into ClearPath, where GHG emissions were calculated based on standard factors for organic content and methane generating potential for each waste type. Emissions were adjusted based on the presence of landfill gas capture systems.

In 2005 and 2015 Placer County recycled and/or composted significant materials (excluding food waste). As is common, in the absence of site specific waste composition data, California default values were used. As noted by County staff, this could impact the emissions significantly. A food waste recycling program was started in 2016.

It is important to acknowledge the benefits of recycling and composting that lower waste volumes and lower emissions. When waste volumes are reduced, collection and transportation emissions are likewise reduced, and when incoming organic waste is diverted, landfill emissions are also reduced. Finally, upstream emissions from materials manufacturing are reduced when recycled materials displace virgin materials. Placer County's One Big Bin¹⁰ policy allows residents, businesses, and visitors to dispose of everything in one bin with recyclables removed at the Material Recovery Facilities. This policy reduces the number of trucks required to pick up trash and recycling and makes recycling easier for residents and visitors.

Solid Waste Collection and Transportation

A variety of emissions are associated with solid waste management services including emissions resulting from collection, processing, and storage of solid waste generated by residents, businesses, and visitors. Collection and transportation emissions are included in transportation sector emissions, but they are also reported separately with the waste sector as an information item.

Solid waste collection emissions include emissions from the trucks used to collect County solid waste within the community and transport the waste to the regional landfills serving Placer County. The tonnage of waste collected and the distance to the landfills were entered into ClearPath to calculate GHG emissions using default per-ton-mile CO₂e emissions (the GHGs emitted to transport one ton of waste one mile).

¹⁰ <http://onebigbin.com/>

Table D-3: Community Solid Waste Landfills GHG Calculation Methods and Emissions Factors

2005 Landfill data	Loomis	Meadow Vista	Foresthill	Eastern Regional	Western Regional
Landfill Gas (LFG) Collected (million standard cubic feet)	12.37	1.58	Assume per-capita emissions are similar to Meadow Vista, but without emissions capture technology. Meadow Vista pop ~3,200 Foresthill pop ~ 1,500	41.63	323.00
% Methane in LFG	0.273	0.258		0.385	0.4497
Destruction Efficiency of Methane	0.9830	0.9902		0.9928	0.9952
Collection Efficiency ¹¹	75%	75%		75%	75%
Methane Soil Oxidation Factor	0.1	0.1		0.1	0.1
Area not covered by LFG Collection System (Square Feet)	-	-	Meadow Vista pop ~3,200 Foresthill pop ~ 1,500	-	327,700
Area covered by LFG Collection System (Square Feet)	522,720	348,480		1,568,160	4,806,500
CH ₄ emitted (Metric Tons)	20.47	2.41	4.38	94.17	1,074.00
2015 Landfill data	Loomis	Meadow Vista	Foresthill	Eastern Regional	Western Regional
Landfill Gas (LFG) Collected (million standard cubic feet)	5.48	0.88	Assume per-capita emissions are similar to Meadow Vista, but without emissions capture technology. Meadow Vista pop ~3,200 Foresthill pop ~ 1,500	37.38	894.00
% Methane in LFG	0.22	0.25		0.23	0.4855
Destruction Efficiency of Methane	0.9830	0.9902		0.9928	0.9991
Collection Efficiency	75%	75%		75%	75%
Methane Soil Oxidation Factor	0.1	0.1		0.1	0.1
Area not covered by LFG Collection System (Square Feet)	-	-	Meadow Vista pop ~3,200 Foresthill pop ~ 1,500	-	-
Area covered by LFG Collection System (Square Feet)	522,720	348,480		1,677,060	6,998,000
CH ₄ emitted (Metric Tons)	7.31	1.30	2.37	50.51	2,497.76
CH ₄ emitted (Metric Tons)	EPA's MRR reported emissions for Western Regional Landfill, which will be what is reported in the inventory per USCP				1,992

¹¹ This is an industry standard number without empirical evidence to suggest it is accurate for any specific facility. Actual collection efficiencies could vary, and given the stringent regulatory standards regarding methane emissions, could be higher.

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Solid Waste Facilities Located in the Community

Placer County has five landfills with full or partial methane-capture systems: Western Regional, Eastern Regional, Meadow Vista, Loomis and Foresthill. Information was provided by County staff. Detailed landfill data is shown in Table D-3. Standard default values were used for collection efficiency (75%) and soil oxidation (0.1). Standard equations from the Local Government Operations Protocol, Ver. 1.1 were used to calculate methane emissions.

Historic dumps and landfills with no methane capture also produce methane emissions. Assumptions regarding associated emissions were developed with ICLEI staff and IPCC information:

- Solid waste generation is proportional to population (using US Census Bureau population data),
- 50% of historic dumps are located in the unincorporated County,
- 25% of waste was burned and 75% went to local dumps,
- 20% of historic dumps were burn dumps (CA Dept. of Toxic Substance Control/ CalRecycle), and
- Dumps generate 60% of emissions of landfills. (IPCC/ICLEI).

These assumptions were used to create the input values necessary for the California Air Resources Board's first-order-decay model to estimate methane emissions

Appendix E – Community Potable Water Use Sector Notes

Table E-1: Community Potable Water Electricity Use Data

Year	Service	Electricity Use (kWh)	Water Production (Million Gallons)	Energy Intensity (kWh / Million Gallons)	Population Served (Full Time Equivalent)	Gallons / Capita / day	Data Source
2005	Default Averages			1,450		209	Water service companies as listed, utilities (PG&E, NV Energy), USCP and CA Water Boards defaults, EPA / CA DOF / US Census population data.
	PCWA - NV Energy	264,420	431	614	3,510	336	
	PCWA - PG&E	4,415,142	8,732	506	67,810	353	
	NTPUD - NV Energy	1,291,468	471	2,742	4,824	267	
	TCPUD - NV Energy	1,092,937	581	1,880	7,495	212	
	NID - PG&E	747,400	585	1,278	8,970	179	
	Foresthill PUD - PG&E	95,969	326	295	4,271	209	
	Sheridan (County) - PG&E	65,305	38	1,714	500	209	
	Other minor suppliers - PG&E	2,401,689	1,656	1,450	13,952	325	
	Other minor suppliers - NV Energy	1,162,220	802	1,450	9,383	234	
	Transmission & Distribution Losses	649,904	(5.333% GLF)				
2005	TOTAL	12,186,454	13,622	847	120,712	309	
2015	Default Averages			1,450		181	Water service companies as listed, utilities (PG&E, NV Energy), USCP and CA Water Boards defaults, EPA / CA DOF / US Census population data.
	PCWA - PG&E	3,731,553	7,380	506	82,316	245	
	NTPUD - Liberty	888,949	315	2,822	4,781	180	
	TCPUD - Liberty	546,437	295	1,852	7,722	105	
	NID - PG&E	553,050	492	1,124	9,590	141	
	Foresthill PUD - PG&E	100,000	340	295	4,860	191	
	Sheridan (County) - PG&E	73,713	43	1,714	538	219	
	Other minor suppliers - PG&E	1,827,088	1,260	1,450	14,853	232	
	Other minor suppliers - Liberty	706,772	487	1,450	9,989	134	
	Transmission & Distribution Losses	423,989	(4.790% GLF)				
2015	TOTAL	8,851,551	10,612	794	134,649	216	

Table E-2: Community Potable Water GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂ lbs/MWh	CH ₄ lbs/GWh	N ₂ O lbs/GWh	Emissions Factor Source
2005 Electricity – PG&E	BE.2.2	489.16	30.24	8.08	2005 PG&E (CO ₂) & 2005 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – NV Energy	BE.2.2	1,900.37	19.13	14.9	2005 Sierra Pacific Power Company (CO ₂) & 2005 U.S. EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2005 Electricity – Direct Access and T&D Losses Western County	BE.2.2	724.12	30.24	8.08	2005 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ , N ₂ O)
2005 Electricity – T&D Losses Eastern County	BE.2.2	902.24	19.13	14.9	2005 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – PG&E	BE.2.2	404.51	33.1	4.0	2015 PG&E (CO ₂) & 2014 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2015 Electricity – Liberty Utilities	BE.2.2	936.97	97.8	14.2	2015 Liberty Utilities (CO ₂) & 2014 EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Western County	BE.4.1	568.6	33.1	4.0	2014 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Eastern County	BE.4.1	907.0	97.8	14.2	2014 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)

Methods:***Community Potable Water Electricity Use***

Unincorporated Placer County's potable water use activity data is shown in Table E-1. Data on the electricity use, water production, and population served was collected from water agencies serving unincorporated Placer County residents, businesses, and visitors. Since all potable water treatment and delivery infrastructure lies within the unincorporated county limits, the electricity use was subtracted from the non-residential sector's PG&E and NV Energy / Liberty Utilities electricity use to prevent double counting. The electricity use was entered into ClearPath where the GHG emissions were calculated using utility-reported grid emissions factors for electricity shown in Table E-2. T&D losses were calculated by applying the EPA eGRID grid loss factors to the relevant electricity used and then entering the loss into ClearPath where the GHG emissions were calculated using the EPA eGRID WECC California and Northwest subregion grid average emissions factors.

Appendix F – Community Wastewater Treatment Sector Notes

Table F-1: Community Wastewater Treatment Electricity Use Data

Year	Service	Electricity Use (kWh)	Wastewater Treated (Million Gallons)	Energy Intensity (kWh / Million Gallons)	Population Served (Full Time Equivalent)	Gallons / Capita / day	Data Source
2005	Default			1,150 – lagoons 2,500 – Central		100	Wastewater service companies listed, utilities (PG&E, Liberty), USCP defaults. EPA / US Census population data. See Table under Methods.
	Placer County Operations – PG&E	1,650,807	774	2,132	15,670	135	
	Roseville Treatment Plant – Roseville Electric	1,323,820	470	2,816	17,056	75.5	
	Auburn Valley Central Plant – PG&E	28,590	11	2,500	313	100	
	Skyview, Heather Glen lagoons – PG&E	8,309	5.8	1,430	523	30	
	Tahoe Area Collection and Treatment – NV Energy & TDPUD	7,360,296	984	7,481	22,021	122	
	T&D Losses	584,289					
2005	Total	10,956,112	2,246	4,878	55,583	111	
2015	Default			1,150 – lagoons 2,500 – Central		100	
	Placer County Operations – PG&E	1,632,179	462	3,534	16,305	78	
	Roseville Treatment Plant – Roseville Electric	1,447,981	514	2,816	18,656	75.5	
	Auburn Valley Central Plant – PG&E	18,309	7	2,500	321	63	
	Skyview, Heather Glen lagoons – PG&E	8,309	5.8	1,430	531	30	
	Tahoe Area Collection and Treatment – Liberty Utilities & TDPUD	4,386,278	597	7,345	23,940	68	
	T&D Losses	376,974					
2015	Total	7,870,031	1,586	4,962	59,752	73	

Table F-2: Community Wastewater Treatment Operations Data

Year	Wastewater Treated (Million Gallons)	Population Served	Nit/Denit Process	Comm/ Ind Factor	Aerobic/ Anaerobic/ Aerated	Digester Gas	Data Source
Tahoe-Truckee Sanitation Agency							
2005	984	22,021	Yes	1.25	Anaerobic	Flared	
2015	597	23,940	Yes	1.25			
SMD#1 (includes Applegate since 2014)							Plant / County Staff
2005	704	13,610	No	1.25	Anaerobic	Flared	
2015	448	15,767					
SMD#3							
2005	55	1,500	Yes	1.25	Anaerobic	Flared	
2015	To Roseville						
Roseville Central Treatment (Unincorporated Placer County resident - generated wastewater (from SMD#2 prior to 2000, and SMD3 in 2014))							Roseville WWTP staff
2005	623	17,056	Yes	1.25	Aerobic	NA	
2015	514	18,656					
Auburn Valley Lagoon							Auburn Valley staff
2005	11	313	Yes	1.25	Aerobic	NA	
2015	7	321					
Year	Wastewater Treated (Million Gallons)	Population Served	Nit/Denit Process	Comm/ Ind Factor	Aerobic/ Anaerobic/ Aerated	Methane Correction Factor	Data Source
Combined Lagoon Systems (Applegate until 2014, Sheridan, Skyview & Heather Glen CSD)							Facility staff
2005	Unknown	1,083	No	1.129	Partially Aerobic	0.3	
2015	Unknown	1,069		1.126			
Septic Systems - Individual and small residential system population							DOF population data
2005 Population: 47,945				2015 Population: 50,462			

Table F-3: Community Wastewater Treatment GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂ lbs/MWh	CH ₄ lbs/GWh	N ₂ O lbs/GWh	Emissions Factor Source
2005 Electricity – PG&E	BE.2.2	489.16	30.24	8.08	2005 PG&E (CO ₂) & 2005 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – NV Energy	BE.2.2	1,900.37	19.13	14.9	2005 Sierra Pacific Power Company (CO ₂) & 2005 U.S. EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2005 Electricity – Roseville Electric	BE.2.2	565.52	30.24	8.08	2006 Roseville Electric (CO ₂), 2005 EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – Direct Access and T&D Losses Western County	BE.2.2	724.12	30.24	8.08	2005 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ , N ₂ O)
2005 Electricity – T&D Losses Eastern County	BE.2.2	902.24	19.13	14.9	2005 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – PG&E	BE.2.2	404.51	33.1	4.0	2015 PG&E (CO ₂) & 2014 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2015 Electricity – Liberty Utilities	BE.2.2	936.97	97.8	14.2	2015 Liberty Utilities (CO ₂) & 2014 EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2015 Electricity – Roseville Electric	BE.2.2	601.86	33.1	4.0	2015 Roseville Electric (CO ₂), 2014 EPA eGRID WECC California (CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Western County	BE.4.1	568.6	33.1	4.0	2014 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Eastern County	BE.4.1	907.0	97.8	14.2	2014 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
Activity / Source	Method	CO ₂	CH ₄	N ₂ O	Emissions Factor Source
Septic Systems (population based)	WW.11(alt)	NA	0.6 kg CH ₄ / kg BOD ₅	NA	USCP App F page 52.
Lagoons (population based) - no primary treatment	WW.6(alt)	NA	0.6 kg CH ₄ / kg BOD ₅	NA	USCP App F page 39, with MCF = 0.3.
Central Plants – with nitrification / denitrification process (population based)	WW.7	NA	NA	7 g N ₂ O / person / year	USCP App F page 41.

Methods:**Community Wastewater Treatment Electricity Use**

Community-generated wastewater treatment activity data for 2005 and 2015 is shown in Tables F-1 and F-2. Data on electricity use, wastewater treated, and population served was collected from wastewater agencies serving unincorporated

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Placer County residents, businesses, and visitors. For wastewater collection and treatment infrastructure that lies within the unincorporated County, the electricity use was subtracted from the non-residential sector's electricity use to prevent double counting. The electricity use was entered into ClearPath where the GHG emissions were calculated using utility-reported grid emissions factors for electricity shown in Table F-3. T&D losses were calculated by applying the EPA eGRID regional grid loss factors to the total electricity use and then entered into ClearPath where the GHG emissions were calculated using the EPA eGRID WECC California sub region grid average emissions factors.

Community Wastewater Treatment Facility Process and Fugitive Emissions

Wastewater treatment emissions account for a small part of total community-based GHG emissions. There are two emissions associated with wastewater treatment processes: methane (CH₄) and nitrous oxide (N₂O). Calculating the makeup and amount of emissions depends on the processes involved and the management practices employed.

There are a number of treatment systems serving unincorporated Placer County, as delineated in Tables F-1 and F-2, including a central treatment plants, lagoon systems, and additional septic systems. The wastewater treatment characteristics shown in Table F-2 were collected from wastewater agencies and county staff. The wastewater treatment activity data was entered into ClearPath where GHG emissions were calculated using the standard methods and emissions factors from the USCP shown in Table F-3.

Uncertainties

According to the latest EPA national inventory of greenhouse gas emissions, considerable uncertainty exists within any of the EPA/IPCC-based methodologies used to estimate wastewater process and fugitive emissions. EPA states that population-based methane emissions could be underestimated by 37% or overestimated by 47% while nitrous oxide emissions could be underestimated by 76% or overestimated by 93%. Emissions estimates based on direct source measurements can possibly have higher accuracy and less uncertainty. This extreme degree of uncertainty exists because these methodologies were originally developed for international countrywide inventories that were mainly population-based. By necessity, these methodologies were generalized “top-down” approaches that sought to provide emissions estimates for countries where detailed information would be impractical to obtain. Although these methodologies had the advantage of being relatively simple to calculate, the trade-off was a compromised level of accuracy. Nevertheless, the methodologies in this Appendix reflect the evolution of knowledge since the development of the LGOP.

Methods are evolving but especially where the emissions are based on population and default inputs, communities should exercise caution in drawing conclusions or establishing policies based on these calculations.

Appendix G – Agriculture, Livestock and Forest Management Sector Notes

Table G-1: Agriculture, Livestock and Forest Management Data

Subsector / Data Source	Units	Activity Data	
		2005	2015
Agricultural equipment (California ARB OFFROAD 2007)	Metric Tons CO ₂ e	26,547	26,476
Diesel pumps (California ARB Emissions Inventory)	Metric Tons CO ₂ e	3,066	3,086
Enteric Fermentation and Manure Management (Crop Reports)	Head Dairy Calves	140	80
	Head Dairy Cows	910	520
	Head Beef Calves	9,388	5,365
	Head Mature Beef Cattle	7,921	4,526
	Head Sheep	5,000	9,000
	Head Swine	500	500
Fertilizer use (Crop Reports)	Acres	18,027	14,668
	Pounds Nitrogen Fertilizer	2,460,996	2,087,689
Lime application (California Department of Food & Ag)	Short Tons	4,957	1,718
Manure management (Crop Reports)	Head Chicken	5,566,331	1,000,000
Pesticide use – Methyl Bromide (California Department of Pesticide Regulation)	Pounds	1,140	0
Residue burning (California ARB)	Acres	2,893	803
Rice cultivation (Crop Reports)	Acres	14,500	9,755
Urea application (California Department of Food & Ag)	Short Tons	112	192
Forestry Area Under Local Control (California Department of Fish and Wildlife)	Acres	198,806	198,806

Methods:

Agriculture, Livestock and Forestry Activity Data

Agriculture activity data was collected from the Placer County crop reports for enteric fermentation, manure management, fertilizer use, and rice cultivation using standard emissions factors and local assumptions confirmed by Placer County Agricultural Commissioner. Agricultural equipment activity data and emissions were collected from ARB's OFFROAD 2007 model for Placer County and diesel pumps activity data and emissions were collected from ARB's Emissions Inventory Appendix for Placer County APCD. Lime and urea application activity data was collected from California Department of Food & Ag. Emissions were calculated using standard emissions factors. Methyl Bromide used as a pesticide was collected from California Department of Pesticide Regulation. Residue burning acreage was collected from ARB's Emissions Inventory for Placer County and used standard emissions factors to estimate emissions. Forestry acres

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under local control was calculated using GIS analysis. PCAQMD provided estimates of 5% forest land treated each year, 13 bone-dry tons of wood waste / acre generated each year, 25% of wood waste treated with open burning, and 45% combustion factor for temperate forests from IPCC guidance. Due to limited data about some agricultural activities, assumptions were made based on information provided by the Placer County Agricultural Commissioner and other sources. The reasonableness of these assumptions was verified by the Placer County Agricultural Commissioner's office. These assumptions are as follows:

- There is one small dairy in Placer County, and all other cattle are raised for beef. It is assumed that 95% of cattle are raised for beef and 5% are dairy cows, and that no replacement cattle are raised in Placer County.
- Based on cost studies from the University of California, it is assumed that beef cattle are weaned until 8 months old, put to pasture until they are 14 to 20 months old (with an equal number of cattle being removed from pasture each month), and sent to a feedlot for 3 to 4 months.
- It is assumed that the average life of a dairy cow is five years.
- Due to winter weather conditions, some beef cattle are moved to lowland pastures in other counties during the colder months. It is assumed that half of beef cattle (not including calves) are moved outside of Placer County during half the year, while the other half of the beef cattle remain in Placer County year-round.
- It is assumed that there is an equal distribution of animals across all age groups.
- It is assumed that the number of swine remained constant at 500 for the calendar years 2005 and 2015.
- As the Placer County Agricultural Commissioner reports alfalfa, fodder corn, and oats as a single category (other field crops), it is assumed that all three are grown at equal amounts.
- Recommended fertilizer rates for many trees vary by the tree's age. The inventory assumes a constant average fertilizer rate, assuming that trees live to their maximum feasible lifespan as indicated by University of California cost studies.
- When farmers apply carbonate limes to soils, it is assumed that both limestone and dolomite are applied in equal amounts across Placer County.
- As the number of chickens in Placer County is unknown in 2005, it is assumed that the number of chickens is proportional to the value of the "other livestock" category (which includes chickens) as reported by the Placer County Agricultural Commissioner.
- It is assumed that anaerobic lagoons are used as the manure management system for swine, and that manure management systems for chickens use layers without litter.
- When discussing agricultural residue, it is assumed that burned acreage reported as "other prunings" and "other field crops" are an equal balance of barley, corn, and wheat.
- It is assumed that rice farmers in Placer County apply straw, compost, and manure to rice-growing acreage in equal amounts.

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Appendix H – Buildings and Facilities Sector Notes

Table H-1: Buildings and Facilities Data

Facility Name	Activity / Source	2005 kWh	2015 kWh	Source
Old Roseville Court Building	Electricity – Roseville	94,622	Sold in 2013	County staff, PG&E, Roseville Elec, NV Energy and Liberty Utilities
Roseville Jail Go-For-Broke Rd	Electricity – Roseville	NA	3,348,300	
Adult Care Services - Cirby Road	Electricity – Roseville	1,235,600	979,000	
Santucci Justice - Justice Cntr Rd	Electricity – Roseville	NA	685,920	
Placer Co Fair Association	Electricity – Roseville	400,850	472,673	
Other Roseville Elec	Electricity – Roseville	47,624	101,707	
Other Tahoe (NV Energy/Liberty)	Elec - NV Energy/Liberty	180,468	479,704	
County Courthouse	Elec - NV Energy/Liberty	200,960	189,664	
TART/CNG	Elec - NV Energy/Liberty	151,833	163,877	
DeWitt and minor Planning	Electricity - PG&E	519,339	NA	
Probation 1st St, C Ave	Electricity - PG&E	403,360	NA	
Sheriff / Jail - Richardson Dr	Electricity - PG&E	2,291,100	2,016,603	
Admin - Richardson Dr	Electricity - PG&E	2,795,700	1,788,727	
2834-2929 Richardson Dr	Electricity - PG&E	117,961	1,383,422	
1000 Sunset Blvd, Rocklin	Electricity - PG&E	NA	1,272,670	
11450 A Ave / County Center Dr	Electricity - PG&E	113,449	977,144	
Other A-F Street Auburn	Electricity - PG&E	518,340	645,387	
Other PG&E	Electricity - PG&E	528,768	625,302	
Libraries	Electricity - PG&E	530,232	616,377	
Health & Human Services	Electricity - PG&E	938,520	627,121	
133- 175 Fulweiler Offices	Electricity - PG&E	630,654	537,745	
Historic Maple St Courthouse	Electricity - PG&E	568,000	104,500	
Parks and Recreation	Electricity - PG&E	250,578	306,498	
Fire Stations	Electricity - PG&E	138,994	301,087	
Communication/IT Bldg B Ave	Electricity - PG&E	259,246	263,365	
11476 - 11500 C Ave	Electricity - PG&E	236,481	218,707	
HHS Child Support Services	Electricity - PG&E	423,200	219,674	
Courts and District Attorney	Electricity - PG&E	759,016	219,328	
Maintenance / Shops / CNG	Electricity - PG&E	418,992	214,011	
Other Sheriff and Security	Electricity - PG&E	663,566	167,750	
Juvenile Hall	Electricity - PG&E	809,100	46,882	
T&D Losses Western	Electricity - eGRID CAMX	884,071	912,616	EPA
T&D Losses Eastern	Electricity - eGRID NWPP	30,041	41,920	
Total	Electricity	17,140,665	19,927,681	

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Facility Name	Activity / Source	2005 therms	2015 therms	Source
Old Roseville Court Building	Natural Gas – PG&E	1,393	Sold in 2013	PG&E, Southwest Gas
Roseville Jail Go-For-Broke Rd	Natural Gas – PG&E	NA	130,342	
Adult Care Services - Cirby Rd	Natural Gas – PG&E	7,310	4,916	
Santucci Justice - Justice Cntr Rd	Natural Gas – PG&E	NA	9,224	
Placer Co Fair Association	Natural Gas – PG&E	7,717	3,914	
Other Roseville	Natural Gas – PG&E	2,177	2,105	
Other Tahoe	Natural Gas – SW Gas	19,521	36,603	
County Courthouse	Natural Gas – SW Gas	10,460	10,805	
TART/CNG (non-vehicle)	Natural Gas – SW Gas	14,530	15,499	
DeWitt and minor Planning	Natural Gas – PG&E	5,623	NA	
Probation 1st St, C Ave	Natural Gas – PG&E	14,180	NA	
Sheriff / Jail - Richardson Dr	Natural Gas – PG&E	90,469	49,551	
Admin - Richardson Dr	Natural Gas – PG&E	30,961	17,043	
2834-2929 Richardson Dr	Natural Gas – PG&E	3,125	40,777	
1000 Sunset Blvd, Rocklin	Natural Gas – PG&E	NA	5,455	
11450 A Ave / 3091 County Center Dr	Natural Gas – PG&E	NA	12,338	
Juvenile Hall	Natural Gas – PG&E	27,181	18,156	
Other A-F Street Auburn	Natural Gas – PG&E	38,660	18,010	
Health & Human Services	Natural Gas – PG&E	39,376	18,646	
133- 175 Fulweiler Offices	Natural Gas – PG&E	8,402	13,664	
Maintenance / Shops / CNG	Natural Gas – PG&E	18,759	13,490	
Other PG&E	Natural Gas – PG&E	22,651	10,460	
Courts and District Attorney	Natural Gas – PG&E	34,262	10,463	
Parks and Recreation	Natural Gas – PG&E	14,763	6,281	
Other Sheriff and Security	Natural Gas – PG&E	39,406	7,520	
Historic Maple St Courthouse	Natural Gas – PG&E	11,863	1,843	
Libraries	Natural Gas – PG&E	9,048	6,237	
Fire Stations	Natural Gas – PG&E	2,772	5,924	
HHS Child Support Services	Natural Gas – PG&E	NA	4,307	
11476 - 11500 C Ave	Natural Gas – PG&E	7,784	3,503	
Total	Natural Gas	482,393	477,076	
Facility Name	Activity / Source	2005 gallons	2015 gallons	Source
Parks and Rec	Propane	22,980	4,474	County staff.
Sheridan	Propane	270	0	
Enterprise Drive	Propane	750	0	
Libraries	Propane	0	849	
Minimum Security	Propane	440	0	
Historic Maple St Courthouse	Propane	230	0	
Communication/IT Building B Ave	Propane	50	0	
Total Propane		24,720	5,323	

Table H-2: Buildings and Facilities GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂ lbs/MWh	CH ₄ lbs/GWh	N ₂ O lbs/GWh	Emissions Factor Source
2005 Electricity – PG&E	BE.2.2	489.16	30.24	8.08	2005 PG&E (CO ₂) & 2005 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – NV Energy	BE.2.2	1,900.37	19.13	14.9	2005 Sierra Pacific Power Company (CO ₂) & 2005 U.S. EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2005 Electricity – Roseville Electric	BE.2.2	565.52	30.24	8.08	2006 Roseville Electric (CO ₂), 2005 EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – T&D Losses Western County	BE.2.2	724.12	30.24	8.08	2005 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ , N ₂ O)
2005 Electricity – T&D Losses Eastern County	BE.2.2	902.24	19.13	14.9	2005 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – PG&E	BE.2.2	404.51	33.1	4.0	2015 PG&E (CO ₂) & 2014 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2015 Electricity – Liberty Utilities	BE.2.2	936.97	97.8	14.2	2015 Liberty Utilities (CO ₂) & 2014 EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2015 Electricity – Roseville Electric	BE.2.2	601.86	33.1	4.0	2015 Roseville Electric (CO ₂), 2014 EPA eGRID WECC California (CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Western County	BE.4.1	568.6	33.1	4.0	2014 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Eastern County	BE.4.1	907.0	97.8	14.2	2014 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
Activity / Source	Method	CO ₂	CH ₄	N ₂ O	Emissions Factor Source
Natural Gas	BE.1.1	53.02 kg/MMBtu	0.005 kg/MMBtu	0.0001 kg/MMBtu	USCP Appendix C - Table B.1 and Table B.3
Propane (LPG)	6.1.1	5.79 kg/gallon	0.0010 kg/MMBtu	0.0001 kg/MMBtu	LGOP Appendix G - Table G.1 (CO ₂), Table G.4 (CH ₄ and N ₂ O)

Methods:

Buildings and facilities electricity and natural gas use data, shown in Table H-1, was collected from utilities and County staff, including Pacific Gas and Electric Company (PG&E), NV Energy/Liberty Utilities, Roseville Electric, and Southwest gas. County staff provided propane data. The activity data was entered into ClearPath where GHG emissions were calculated using the calculation methods and emissions factors shown in Table H-2.

Table H-3: Public Lighting Data

Record Name	Activity / Source	2005 kWh	2015 kWh	Source
Western Traffic Signals	Electricity - PG&E	175,525	69,200	Pacific Gas and Electric
Western Streetlights	Electricity - PG&E	64,811	85,484	Pacific Gas and Electric
All Tahoe Lighting	Electricity - NV Energy/Liberty	699	38,181	NV Energy / Liberty Utilities
T&D Losses Western	Electricity - eGRID California	13,539	7,782	EPA
T&D Losses Eastern	Electricity - eGRID Northwest	39	1,921	
Total Lighting	Electricity	254,614	202,568	
LS1 PG&E Lighting (Info Item)	Electricity - PG&E	322,354	349,843	Pacific Gas and Electric
LS1 T&D Losses (Info Item)	Electricity - eGRID California	18,160	17,601	EPA
Total LS1 Lighting (Info Item)	Electricity	340,514	367,444	

Public lighting electricity use data, shown in Table H-3, was collected from PG&E and NV Energy/Liberty Utilities. Activity data was entered into ClearPath where GHG emissions were calculated using the calculation methods and emissions factors shown in Table H-2. PG&E-designated LS-1 lighting was included as an Information Item. LS-1 designated streetlights are owned, operated, maintained and directly paid for by PG&E, but are indirectly paid for by the County through their general rate case with PG&E.

Appendix I – Vehicle Fleet, Transit Fleet, and Mobile Equipment Sector Notes

Table I-1: Vehicle Fleet and Mobile Equipment Data

Activity/Source: (On-road unless otherwise noted)	Vehicle category	2005		2015	
		Fuel Use	VMT	Fuel Use	VMT
		Gallons	Miles	Gallons	Miles
Admin Services and District Attorney Gasoline	Passenger Car	6,479	142,147	5,075	126,409
	Light Trucks & SUVs	4,766	65,618	9,970	163,987
Facility Services Gasoline	Passenger Car	809	15,535	367	10,809
	Light Trucks & SUVs	25,877	332,679	15,924	214,756
	Heavy Trucks	15,986	137,751	23,166	207,168
Health & Human Services Gasoline	Passenger Car	9,905	213,130	16,342	465,754
	Light Trucks & SUVs	11,774	181,383	33,490	448,321
Probation Gasoline	Passenger Car	6,209	128,914	297	3,566
	Light Trucks & SUVs	5,372	66,785	11,528	165,264
Public Works Gasoline	Passenger Car	1,389	40,447	1,616	40,798
	Light Trucks & SUVs	53,609	623,246	29,079	353,899
	Heavy Trucks	24,140	199,204	22,032	208,147
	Off Road	7,538	NA	1,645	NA
Sheriff Gasoline	Passenger Car	150,679	1,838,327	41,359	517,929
	Light Trucks & SUVs	101,157	1,081,140	165,776	1,974,888
	Off Road			237	NA
Other Departments Gasoline	Passenger Car	24,906	562,492	8,488	259,220
	Light Trucks & SUVs	121,272	1,708,238	63,050	943,826
	Heavy Trucks			886	8,025
	Off Road			263	NA
TOTAL Gasoline	On Road	564,327	7,337,036	448,445	6,112,766
	Off Road	7,538	NA	2,145	NA
Activity/Source: (On-road unless otherwise noted)	Vehicle category	2005		2015	
		Fuel Use	VMT	Fuel Use	VMT
		Gallons	Miles	Gallons	Miles
Facility Services Diesel	Heavy Trucks	10,921	68,048	9,933	58,812
	Off Road			137	NA
Public Works Diesel	Light Trucks & SUVs	2,541	33,223	1,753	23,172
	Heavy Trucks	17,828	88,449	46,675	246,054
	Off Road	27,250	NA	28,919	NA

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Sheriff Diesel	Heavy Trucks	2,206	17,723	3,423	29,949
	Off Road			1,152	NA
Other Departments Diesel	Heavy Trucks	1,695	11,423	8,605	14,594
	Off Road		NA	3,182	NA
TOTAL Diesel	On Road	35,190	218,866	70,390	372,581
	Off Road	27,250	NA	33,389	NA
Activity/Source: (On-road unless otherwise noted)	Vehicle category	2005	2015	2005	2015
		Fuel Use	VMT	Fuel Use	VMT
		Therms	Miles	Therms	Miles
Facility Services CNG	Light Trucks & SUVs	54	759		
	Heavy Trucks			233	2,068
Public Works CNG	Light Trucks & SUVs	1,657	14,100	2,654	21,349
	Heavy Trucks	54	NA	2,797	5,329
Other Departments CNG	Passenger Cars	3,371	44,816	1,991	5,430
	Light Trucks & SUVs			2,139	44,132
TOTAL CNG	On Road	5,136	59,675	9,813	78,308
Activity/Source:	Vehicle category	2005	2015	2005	2015
		Fuel Use	VMT	Fuel Use	VMT
		Gallons	Miles	Gallons	Miles
Public Works Propane	Off Road	12,840	NA	0	NA
Number of Vehicles w/ Air Conditioning (Gas + Diesel)	To 1994 (R-12)	1		0	
	1995+ (R-134a)	754		812	
Data Source:	County Staff				

Table I-2: Transit Fleet Data

Vehicles	Units	2005		2015	
		Annual Units	VMT (Miles)	Annual Units	VMT (Miles)
Trolley / Phantom (Heavy Truck)	Gallons Diesel	21,749	150,300	Sold	
Buses (Heavy Truck)	Gallons Diesel	10,526	66,328	51,630	265,219
Total CNG Buses	Standard Cubic Feet	21,370,410	775,227	30,158,963	998,316
Number of vehicles	1995+ (R-134a)	32		33	
Data Source:	County Staff				

Table I-3: Vehicle Fleet, Transit Fleet, and Equipment GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂ kg / gallon	CH ₄ grams / mile	N ₂ O grams / mile	CH ₄ grams / mile	N ₂ O grams / mile	Emissions Factor Source
			2005		2015		
On-Road Passenger Vehicles - Gasoline	7.1.1.1 and 7.1.3.3	8.78	0.042227	0.017880	0.018309	0.012712	LGOP Appendix G - Table G.11 (CO ₂) and California ARB EMFAC 2014 Placer County (CH ₄ and N ₂ O)
On-Road Light Trucks - Gasoline	7.1.1.1 and 7.1.3.3	8.78	0.047611	0.030460	0.020472	0.018931	
On-Road Heavy Trucks - Gasoline	7.1.1.1 and 7.1.3.3	8.78	0.171212	0.081697	0.093071	0.039408	
On-Road Passenger Vehicles - Diesel	7.1.1.1 and 7.1.3.3	10.21	0.010771	0.011081	0.002048	0.009895	
On-Road Light Trucks - Diesel	7.1.1.1 and 7.1.3.3	10.21	0.013428	0.017055	0.001219	0.015723	
On-Road Heavy Trucks - Diesel	7.1.1.1 and 7.1.3.3	10.21	0.046187	0.042924	0.035400	0.043429	
On-Road Passenger Car - CNG	7.1.1.1 and 7.1.3.3	0.054 kg / scf	0.737	0.05	0.737	0.05	LGOP Appendix G - Table G.11 (CO ₂) & G.13 (CH ₄ and N ₂ O)
On-Road Light Trucks - CNG	7.1.1.1 and 7.1.3.3	0.054 kg / scf	0.737	0.05	0.737	0.05	
On-Road Heavy Trucks - CNG	7.1.1.1 and 7.1.3.3	0.054 kg / scf	1.966	0.175	1.966	0.175	
Off-Road Equipment - Gasoline	7.2	8.78	0.22 grams / gallon	0.50 grams / gallon	0.22 grams / gallon	0.50 grams / gallon	LGOP Appendix G - Table G.11 (CO ₂) and Table G.14 (CH ₄ and N ₂ O)
Off-Road Equipment - Diesel	7.2	10.21	0.26 grams / gallon	0.58 grams / gallon	0.26 grams / gallon	0.58 grams / gallon	LGOP Appendix G - Table G.11 (CO ₂) and Table G.14 (CH ₄ and N ₂ O – large utility proxy)
Off-Road Equipment – Propane (LPG)	7.2	5.59	0.066	0.175	0.066	0.175	LGOP Appendix G - Table G.11 (CO ₂) & G.13 (CH ₄ and N ₂ O)
Refrigerants	7.4	NA	NA	NA	NA	NA	LGOP

Methods:

Vehicle fleet information was collected from Placer County records. Vehicle lists, fuel use, and vehicle miles traveled (VMT) data by departments was obtained directly from County staff. The summarized fuel use and VMT activity data is

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shown in Tables I-1 for the vehicle fleet and mobile equipment and Table I-2 for the transit fleet, and was entered into ClearPath where GHG emissions were calculated using the standard methods and emissions factors outlined in the LGOP and shown in Table I-3.

Due to data limitations, the fugitive emissions from vehicle air conditioning refrigerants were estimated using the LGOP alternate approach, which may overestimate emissions. Given the make and year of the vehicles, the refrigerant was presumed to be R-134a if the vehicle was a 1995 model or newer. The majority of automakers changed their refrigerant of choice from R-12 to R-134a during that year. This alternate approach estimates refrigerant leakage at the highest potential during normal use and maintenance and likely is higher than if refrigerant use was tracked directly.

Appendix J – County-Generated Solid Waste Sector Notes

Table J-1: County-Generated Solid Waste Data

County Facility Name	2005 Wet Tons	2015 Wet Tons	Density (lb/CY)	Data Source
Jail Facility - 2775 Richardson	342	430	300	County staff & Tahoe Truckee Sierra Disposal
Minimum Security	152	33	300	
AJC (Justice Center)	New since 2005	33	89	
Public Works	28	28	89	
Animal Control	25	25	89	
FAB Building	25	25	89	
Mental Health Diner	24	14	300/89 ¹²	
Building Maintenance – 2800 second St.	New since 2005	28	89	
Minor Facilities	162	151	89	
Tahoe Facilities	33	34	89	
Total County Operations Generated Waste	791	800	300/89	
Total Community Generated Waste (e.g. park cans)	110	108	300	

Table J-2: Solid Waste GHG Calculation Methods and Emissions Factors – Community Waste

Activity / Source	Method	Type	2004 % by Weight for 2005	2015 % by Weight	Emissions Factor (metric tons CH ₄ /wet short ton)	Percentages and Emissions Factor Source
Community-Generated Statewide Waste	12.2.2	Newspaper	3.2	1.2	0.043	CalRecycle California Statewide Waste Characterization Study (2004 proxy for 2005) and CalRecycle 2015
		Office Paper	5.5	4.6	0.203	
		Corrugated Cardboard	5.7	3.3	0.120	
		Magazines/Third Class Mail	6.7	8.1	0.049	
		Food Scraps	14.6	18.7	0.078	
		Grass	2.1	1.1	0.038	
		Leaves	2.1	2.7	0.013	
		Branches	2.6	4.8	0.062	
		Dimensional Lumber	9.6	11.9	0.062	
		All other (Non-Organic)	NA	NA	0	USCP Appendix E (Page 34) & U.S. EPA Waste Reduction Model (WARM)

¹² In 2005 waste from the Diner was modeled as community waste (300 lb/CY) but the Diner was converted to offices by 2015 and waste from that location was modeled as administrative waste (89 lb/CY).

Table J-3 Solid Waste GHG Calculation Methods and Emissions Factors – Public Admin Waste

Activity / Source	Method	Type	1999 % by Weight for 2005	2015 % by Weight	Emissions Factor	Emissions Factor Source
Government-Generated Public Administration Waste	12.2.2	Newspaper	5.7	2.3	0.043	CIWMB 1999 Public Admin for 2005 County Operations Solid Waste, and CalRecycle 2015
		Office Paper	13.2	10.5	0.203	
		Corrugated Cardboard	5.1	3.1	0.120	
		Magazines/Third Class Mail	15.4	18.7	0.049	
		Food Scraps	9.8	17.2	0.078	
		Grass	8.1	1.2	0.038	USCP Appendix E (Page 34) & U.S. EPA Waste Reduction Model (WARM)
		Leaves	8.1	1.2	0.013	
		Branches	0.1	0.1	0.062	
		Dimensional Lumber	5	6.5	0.062	
		All other (Non-Organic)	NA	NA	0	

Methods:

The government-generated solid waste data was collected from Tahoe Truckee Sierra Disposal and County staff primarily in the form of specific-sized bins collected on a stated schedule for 2005 and 2015. The tonnage of solid waste, shown in Table J-1, was calculated using a density of 89 lbs per cubic yard, provided by the California Integrated Waste Management Board (CIWMB) specifically tailored to public administration waste, and 300 lbs per cubic yard for community-generated waste, which is the value for un-compacted residential waste. Community-generated waste (e.g. park cans) collected and paid for by the County is reported as an Information Item since it is not directly tied to County operations and the County cannot control the generation of this waste. The CIWMB was replaced by the California Department of Resources Recycling and Recovery (CalRecycle). The solid waste generated within Placer County was transferred first to one of two Materials Recovery Facilities, where recyclable material is both mechanically and manually separated to divert it from the landfill, and the residual waste is taken to managed landfills for disposal, which all had (and have) landfill gas capture systems in place. The emissions associated with this waste occur at the landfill sites over the entire period of decomposition (estimated to be about 100 years).

In 2005 and 2015 Placer County recycled and/or composted significant materials (excluding food waste). As is common, in the absence of site specific waste composition data, California default values were used, as noted in the next paragraph. As noted by County staff, this could impact the emissions significantly. A food waste recycling program was started in 2016.

The solid waste tonnage activity data was entered into ClearPath where GHG emissions were calculated using CalRecycle's public administration and CalRecycle's statewide waste characterization percentages coupled with standard emissions factors adopted by the California Air Resources Board, the California Climate Action Registry, ICLEI - Local Governments for Sustainability and The Climate Registry and shown in Tables J-2 and J-3.

Table J-4: Solid Waste Facilities Energy Use Data

Record Name	Activity / Source	2005 kWh	2015 kWh	Data Source
Loomis Landfill	Electricity - PG&E	7,979	5,252	Pacific Gas and Electric
Meadow Vista Landfill	Electricity - PG&E	2,937	5,534	Pacific Gas and Electric
Eastern Regional Landfill and MRF (62% allocation)	Electricity - NV Energy/Liberty	335,977	307,992	NV Energy / Liberty Utilities Estimates by Walt Schwall
Western Regional Landfill and MRF (42% allocation)	Electricity - PG&E	699,027	997,357	Pacific Gas and Electric Estimates by Eric Otto
T&D Losses Western	Electricity - eGRID California	39,994	50,720	EPA
T&D Losses Eastern	Electricity - eGRID Northwest	18,927	15,495	EPA
Total	Electricity	1,104,841	1,382,350	
Eastern Regional Landfill and MRF (62% allocation)	Propane (gallons)	52,252	52,252	Estimates by Walt Schwall
Western Regional Landfill and MRF (42% allocation)	Diesel (gallons)	3,638	5,671	Estimates by Walt Schwall

Table J-5: Solid Waste Facilities GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂ lbs/MWh	CH ₄ lbs/GWh	N ₂ O lbs/GWh	Emissions Factor Source
2005 Electricity – PG&E	BE.2.2	489.16	30.24	8.08	2005 PG&E (CO ₂) & 2005 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – NV Energy	BE.2.2	1,900.37	19.13	14.9	2005 Sierra Pacific Power Company (CO ₂) & 2005 U.S. EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2005 Electricity – T&D Losses Western County	BE.2.2	724.12	30.24	8.08	2005 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ , N ₂ O)
2005 Electricity – T&D Losses Eastern County	BE.2.2	902.24	19.13	14.9	2005 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – PG&E	BE.2.2	404.51	33.1	4.0	2015 PG&E (CO ₂) & 2014 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2015 Electricity – Liberty Utilities	BE.2.2	936.97	97.8	14.2	2015 Liberty Utilities (CO ₂) & 2014 EPA eGRID WECC Northwest (CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Western County	BE.4.1	568.6	33.1	4.0	2014 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ and N ₂ O)
2015 Electricity – T&D Losses Eastern County	BE.4.1	907.0	97.8	14.2	2014 U.S. EPA eGRID WECC Northwest (CO ₂ , CH ₄ and N ₂ O)
Activity / Source	Method	CO ₂	CH ₄	N ₂ O	Emissions Factor Source
Diesel	6.1.1	10.21 kg/gallon	0.0015 kg/gallon	0.0001 kg/gallon	LGOP Appendix G - Table G.1 (CO ₂), Table G.4 (CH ₄ and N ₂ O)

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Propane (LPG)	6.1.1	5.79 kg/gallon	0.0010 kg/MMBtu	0.0001 kg/MMBtu	LGOP Appendix G - Table G.1 (CO ₂), Table G.4 (CH ₄ and N ₂ O)
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Energy use activity data for solid waste facilities shown in Table J-4 was collected from PG&E, NV Energy, Liberty Utilities and estimated for contracted services by County staff and was entered into ClearPath where GHG emissions were calculated using the standard methods and emissions factors outlined in the LGOP and shown in Table J-5. T&D losses were calculated by applying the EPA eGRID regional grid loss factors to the total electricity use and then entered into ClearPath where the GHG emissions were calculated using the EPA eGRID WECC California or WECC Northwest sub region grid average emissions factors.

Table J-6: County-Operated Solid Waste Facilities

2005 Landfill data	Loomis	Meadow Vista	Foresthill	Eastern Regional	Western Regional
Landfill Gas (LFG) Collected (million standard cubic feet)	12.37	1.58	Assume per-capita emissions are similar to Meadow Vista, but without emissions capture technology. Meadow Vista pop ~3,200 Foresthill pop ~1,500	41.63	323.00
% Methane in LFG	0.273	0.258		0.385	0.450
Destruction Efficiency of Methane	0.9830	0.9902		0.9928	0.9952
Collection Efficiency	75%	75%		75%	75%
Methane Soil Oxidation Factor	0.1	0.1		0.1	0.1
Area not covered by LFG Collection System (Square Feet)	-	-	Foresthill pop ~1,500	-	327,700
Area covered by LFG Collection System (Square Feet)	522,720	348,480		1,568,160	4,806,500
Metric Tons (MT) CH ₄ emitted	20.47	2.41	4.38	94.17	1,074
Metric Tons CH₄ Allocated to County¹³	20.47	2.41	4.38	43.79	451.08
2015 Landfill data	Loomis	Meadow Vista	Foresthill	Eastern Regional	Western Regional
Landfill Gas (LFG) Collected (million standard cubic feet)	5.48	0.88	Assume per-capita emissions are similar to Meadow Vista, but without emissions capture technology. Meadow Vista pop ~3,200 Foresthill pop ~1,500	37.38	894.00
% Methane in LFG	0.22	0.25		0.23	0.4855
Destruction Efficiency of Methane	0.9830	0.9902		0.9928	0.9991
Collection Efficiency	75%	75%		0.75	0.75
Methane Soil Oxidation Factor	0.1	0.1		0.10	0.10
Area not covered by LFG Collection System (Square Feet)	-	-	Foresthill pop ~1,500	-	-

¹³ 46.5% of Eastern Regional based on historic waste volumes from unincorporated Placer County and 42% of Western Regional based on JPA.

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Area covered by LFG Collection System (Square Feet)	522,720	348,480		1,677,060	6,998,000
Metric Tons CH ₄ emitted	7.31	1.30	2.37	50.51	2,497.76
Metric Tons CH ₄ emitted	EPA's MRR reported emissions for Western Regional Landfill.				1,992
Metric Tons CH₄ Allocated to County¹⁴	7.31	1.30	2.37	23.70	836.6
Data Source:	SCS Engineering, County staff and reports. Western Placer Waste Management Authority.				

Methane (CH₄) emissions from solid waste landfills in unincorporated Placer County were estimated using the activity data and assumptions in Table J-6 provided by County staff using the standard formulas in the LGOP.

¹⁴ 46.5% of Eastern Regional based on historic waste volumes from unincorporated Placer County and 42% of Western Regional based on JPA.

Appendix K – County-Operated Wastewater Treatment Sector Notes

Table K-1: County-Operated Wastewater Treatment Data

Year	Service	Electricity Use (kWh)	Wastewater Treated (MG)	Energy Intensity (kWh/MG)	Population Served (FTE)	Gallons / Capita / day	Data Source
2005	SMD#1 – PG&E	1,098,820	704	1,561	13,610	142	County staff.
	SMD#2 – PG&E	50,239	NA	NA	NA	NA	
	SMD#3 – PG&E	191,208	55	3,490	1,500	100	
	Sheridan Lagoon – PG&E	128,352	14	9,168	500	77	
	Lift Stations – PG&E	180,966					
	Applegate Lagoon – PG&E	1,222	2	727	60	77	
	T&D Losses Western	92,997					
	Total Electricity (kWh)	1,743,804					
	Total Propane (Gallons)	24,314					
2015	SMD#1 – PG&E	1,147,673	448	2,563	15,767	78	County staff.
	SMD#2 – PG&E	59,949	NA	NA	NA	NA	
	SMD#3 – PG&E	47,167	NA	NA	NA	NA	
	Sheridan – PG&E	149,336	14	10,667	538	71	
	Lift Stations – PG&E	226,469					
	Applegate Lagoon – PG&E	1,585	NA		NA		
	T&D Losses Western	82,115					
	Total Electricity (kWh)	1,714,294					
	Total Propane (Gallons)	3,723					

Table K-2: Wastewater Facilities GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂ lbs/MWh	CH ₄ lbs/GWh	N ₂ O lbs/GWh	Emissions Factor Source
2005 Electricity – PG&E	BE.2.2	489.16	30.24	8.08	2005 PG&E (CO ₂) & 2005 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)
2005 Electricity – T&D Losses Western County	BE.2.2	724.12	30.24	8.08	2005 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ , N ₂ O)
2015 Electricity – PG&E	BE.2.2	404.51	33.1	4.0	2015 PG&E (CO ₂) & 2014 U.S. EPA eGRID WECC California (CH ₄ and N ₂ O)

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2015 Electricity – T&D Losses Western County	BE.4.1	568.6	33.1	4.0	2014 U.S. EPA eGRID WECC California (CO ₂ , CH ₄ and N ₂ O)
Activity / Source	Method	CO₂	CH₄	N₂O	Emissions Factor Source
Propane (LPG)	6.1.1	5.79 kg/gallon	0.0010 kg/MMBtu	0.0001 kg/MMBtu	LGOP Appendix G - Table G.1 (CO ₂), Table G.4 (CH ₄ and N ₂ O)

Table K-3: County-Operated Wastewater Treatment Operations Data

Year	Wastewater Treated (MG)	Population Served	Nit/Denit Process	Comm/ Ind Factor	Aerobic/ Anaerobic / Aerated	Digester Gas	Data Source
SMD#1							County Staff
2005	704	13,610	No	1.25	Anaerobic	Flared	
2015	448	15,767					
SMD#2 – to Roseville							
SMD#3							
2005	55	1,500	Yes	1.25	Anaerobic	Flared	
2015	To Roseville						
Year	Wastewater Treated (MG)	Population Served	Nit/Denit Process	Comm/ Ind Factor	Aerobic/ Anaerobic / Aerated	Methane Correction Factor	Data Source
Applegate Lagoon							County staff
2005	Unknown	60	No	1.25	Anaerobic	0.8	
2015	Routed to SMD#1						
Sheridan Aerated Lagoon							County staff
2005	14	500	No	1.25	Partially Aerobic	0.3	
2015	14	538					
Septic Systems – Blue Canyon and Forest Hill							County staff
2005 Population: 28			2015 Population: 28				

Table K-4: Wastewater Treatment GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂	CH ₄	N ₂ O	Emissions Factor Source
Septic Systems (population based)	WW.11(alt)	NA	0.6 kg CH ₄ / kg BOD ₅	NA	USCP App F page 52.
Lagoons (population based) - no primary treatment	WW.6(alt)	NA	0.6 kg CH ₄ / kg BOD ₅	NA	USCP App F page 39, with MCF = 0.3.

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Central Plants – with nitrification / denitrification process (population based)	WW.7	NA	NA	7 g N ₂ O / person / year	USCP App F page 41.
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Methods:

Wastewater Treatment Electricity Use

Wastewater treatment activity data for 2005 and 2015 is shown in Tables K-1 Data on electricity use, propane use, wastewater treated and population served was collected from County staff. The electricity use was entered into ClearPath where the GHG emissions were calculated using utility-reported grid emissions factors for electricity shown in Table K-2. T&D losses were calculated by applying the EPA eGRID regional grid loss factors to the total electricity use and then entered into ClearPath where the GHG emissions were calculated using the EPA eGRID WECC California sub region grid average emissions factors.

Wastewater Treatment Facility Process and Fugitive Emissions

There are two emissions associated with wastewater treatment processes: methane (CH₄) and nitrous oxide (N₂O). Calculating the makeup and amount of emissions depends on the processes involved and the management practices employed. There are a number of treatment systems operated by Placer County, as delineated in Tables K-3, including a central treatment plant, lagoon systems, and additional septic systems. The wastewater treatment characteristics shown in Table K-3 were collected from County staff. The wastewater treatment activity data was entered into ClearPath where GHG emissions were calculated using the standard methods and emissions factors from the USCP shown in Table K-4.

Appendix L – Employee Commute and Business Travel Sector Notes

Table L-1: Employee Commute Data

Fuel	Vehicle Type	2005 Vehicle Miles Traveled	2015 Vehicle Miles Traveled	Average Miles Per Gallon		Data Source
				2005	2015	
Number of Employees	NA	2005: 2,461 employees	2015: 2,349 employees	NA	NA	County Staff
Gasoline	Passenger Cars	10,974,595	10,842,913	26.11	26.7	2010 Employee Commute Survey for 2005.
	Light Trucks	6,402,127	6,798,517	17.73	19.5	
	Heavy Trucks	176,914	44,386	15.75	14.0	
Diesel	Passenger Cars	78,238	5,392	40	30.0	2017 Employee Commute Survey for 2015.
	Light Trucks	89,415	141,495	16.69	16.8	
	Heavy Trucks	151,048	124,208	16.38	16.5	
Electric	Passenger Cars	NA	85,426	NA	NA	

Table L-2: Business Travel Data

Travel Type	2005 Vehicle Miles Traveled	2015 Vehicle Miles Traveled	Notes	Data Source
Number of Employees:	2005: 2,461 employees	2015: 2,349 employees		County Staff
Personal Vehicles	3,464,236	3,306,578	Model as Gasoline, 50:50 cars/trucks, employee commute MPG	2017 Employee Commute Survey. EMFAC, BART, Wall Street Journal
County Owned Vehicles	2,278,504	2,174,809	Model as Gasoline, 50:50 cars/trucks 2005 MPG = 19.92, 2015 MPG = 21.16 from EMFAC	
Public Transit	18,697	17,846	Model as Transit bus	
Airplane	1,003,908	958,220	79.7% short haul, 20.1% med haul, 0.2% long haul.	

Table L-3: Employee Commute GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂ kg / gallon	CH ₄ grams / mile	N ₂ O grams / mile	CH ₄ grams / mile	N ₂ O grams / mile	Emissions Factor Source
			2005		2015		
On-Road Passenger Vehicles - Gasoline	7.1.1.1 and 7.1.3.3	8.78	0.042227	0.017880	0.018309	0.012712	LGOP Appendix G - Table G.11 (CO ₂) and California ARB EMFAC 2014 Placer County (CH ₄ and N ₂ O)

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On-Road Light Trucks - Gasoline	7.1.1.1 and 7.1.3.3	8.78	0.047611	0.030460	0.020472	0.018931	
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Table L-4: Business Travel GHG Calculation Methods and Emissions Factors

Activity / Source	Method	CO ₂ kg / mile	CH ₄ grams / mile	N ₂ O grams / mile	Emissions Factor Source
Air Travel – short haul	12.2.1	0.251	0.0039	0.0083	Default emissions factors from USEPA Climate Leaders Emissions Factors reference sheet ¹⁵
Air Travel – medium haul	12.2.1	0.143	0.0000	0.0047	
Air Travel – long haul	12.2.1	0.167	0.0006	0.0056	
Personal Vehicle	12.2.1	Same as Employee Commute Gasoline – 50% Passenger Vehicles, 50% Light Trucks			LGOP Appendix G - Table G.11 (CO ₂) and CARB EMFAC
County Vehicle	12.2.1				
Transit Bus	12.2.1	Default emissions factors from USEPA Climate Leaders			

Methods:

Employee commute emissions were calculated using employee surveys conducted in 2010 (for 2005 inventory) and 2017 (for 2015 inventory). Business travel emissions were estimated using the 2017 employee survey. The surveys collected information regarding travel distances, modes and frequency. Vehicle miles traveled (VMT) and average miles per gallon (MPG) were estimated from the survey data. VMT data was extrapolated to the number of employees in 2005 and 2015. The VMT activity data, shown in Table L-1, was then entered into ClearPath where GHG emissions were calculated using the methods and emissions factors shown in Table L-3. The calculated average MPG for each vehicle and fuel type was used to convert VMT to fuel use for the CO₂ emissions calculations. Business-travel activity data derived from the employee surveys is shown in Table L-2 and was entered into ClearPath where GHG emissions were calculated using the methods and emissions factors shown in Table L-4.

¹⁵ <http://www.epa.gov/climateleadership/documents/emission-factors.pdf>

List of Acronyms

ACS: American Community Survey

ADC: Alternative Daily Cover

Ag: Agriculture

Alt: Alternative

App: Appendix

ARB: California Air Resources Board

BOD₅: Biochemical Oxygen Demand

CalRecycle: California Department of Resources
Recycling and Recovery

CIWMB: California Integrated Waste Management
Board

CAMX: California eGRID Subregion

CARB: California Air Resources Board

CCAR: California Climate Action Registry

CEC: California Energy Commission

CH₄: Methane

CH₄_Totex: Methane Total Exhaust

CNG: Compressed Natural Gas

CO₂: Carbon Dioxide

CO₂e: Carbon Dioxide Equivalent

Comm/Ind: Commercial/Industrial

CY: Cubic Yards

DOF: California Department of Finance

DA: Direct Access

EF: Emissions Factor

eGRID: U.S. EPA's Emissions & Generation
Information Database

EIA: United States Energy Information
Administration

EMFAC 2014: California ARB's On-Road Mobile
Source Motor Vehicles Emissions Inventory

EPA: United States Environmental Protection
Agency

FTE: Full Time Equivalent

g: Gram(s)

ggl: Grid Gross Loss

GHG: Greenhouse Gas

GLF: Grid Loss Factor

GWP: Global Warming Potential

HHS: Health and Human Services

ICLEI: ICLEI – Local Governments for
Sustainability USA

IPCC: Intergovernmental Panel on Climate Change

JPA: Joint Powers Authority

kg: Kilogram(s)

kWh: Kilowatt-hour(s)

lbs: Pounds

LFG: Landfill Gas

LGOP: Local Government Operations Protocol

LPG: Liquefied Petroleum Gas (Propane)

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LS-1: PG&E Designation for Streetlights Owned and Operated by PG&E

MCF: Methane Conversion Factor

MG: Million Gallons

MMBtu: Million British Thermal Units

MPG: Miles per Gallon

MRF: Materials Recovery Facility

MRR: Mandatory Reporting Rule

NA: Not Applicable

NID: Nevada Irrigation District

Nit/Denit: Nitrification / Denitrification

N₂O: Nitrous Oxide

NO_x: Oxides of Nitrogen

NO_x_Totex: Oxides of Nitrogen Total Exhaust

NTPUD: North Tahoe Public Utility District

NWPP: Northwest eGRID Subregion

OFFROAD 2007: California ARB's Off-road and Mobile Equipment Emissions Model

PC 2014: California ARB's Pleasure Craft Emissions Model

PCAPCD: Placer County Air Pollution Control District

PCWA: Placer County Water Agency

PG&E: Pacific Gas and Electric Company

Pop: Population

PUD: Public Utility District

PV: Photovoltaic

R-12: Dichlorodifluoromethane (Freon-12)

R-134a: Tetrafluoroethane (HFC-134a)

RV 2013: California ARB's Recreation Vehicles Emissions Model

SACOG: Sacramento Area Council of Governments

SACSIM: Sacramento Activity Based Travel Simulation Model

SBC: Sierra Business Council

SEDS: State Energy Data System

SEEC: Statewide Energy Efficiency Collaborative

SF₆: Sulfur Hexafluoride

SMD: Sewer Maintenance District

SMUD: Sacramento Municipal Utility District

SUV: Sport Utility Vehicle

T&D: Transmission and Distribution

TART: Tahoe Truckee Area Regional Transit

TCPUD: Tahoe City Public Utility District

TDPUD: Truckee Donner Public Utility District

TRPA: Tahoe Regional Planning Agency

US: United States

USCP: United States Community Protocol

VMT: Vehicle Miles Traveled

WARM: U.S. EPA's Waste Reduction Model

WECC: Western Electricity Coordinating Council

WW: Wastewater

WWTP: Wastewater Treatment Plant

Glossary of Terms

Baseline year: The year against which future changes are measured. In this Plan, the baseline year for greenhouse gas emissions in 2005.

Biogenic Fuel: Fuel derived from organic material, such as agricultural or forestry waste, food scraps, or crops grown expressly for energy purposes.

California Air Resources Board (CARB): The state agency responsible for regulating air pollution throughout California. Assembly Bill 32 also directs the agency to monitor greenhouse gas emissions in California, and to achieve adopted greenhouse gas reduction targets through market-based and regulatory actions (CARB 2017).

Carbon dioxide (CO₂): A colorless, odorless gas produced by natural and human processes, including burning fossil fuels. The most common greenhouse gas and the single greatest contributing gas to climate change (EIA 2017).

Carbon dioxide equivalent (CO₂e): A unit used to measure the combined emissions from multiple types of greenhouse gas, based on their individual global warming potentials (EIA 2017).

Climate change: A long-term change in the average meteorological conditions (such as temperature, precipitation, and wind) in an area. It can be caused by natural or human factors, but in this Plan, refers to the rapid human-caused climate change that is currently occurring (IPCC 2012).

Direct access (DA): A program in which participants buy power from a supplier other than the standard utility or utilities present in the community. Direct access customers are usually large facilities such as industrial operations or institutions (EIA 2017).

Electric vehicle (EV): A vehicle driven by electric motors, powered by electricity from an on-board battery that can be recharged by plugging the vehicle in to a wall outlet or a special charger (CARB 2017).

Emission factor: A number that describes the amount of greenhouse gases released per unit of activity performed, for example, the amount of greenhouse gases emitted per mile traveled by a vehicle. Sometimes called an emissions coefficient (EIA 2017).

Energy conservation: Reducing energy waste by decreasing the use of devices that use energy, such as switching off lights or appliances when not in use.

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Energy efficiency: Reducing energy waste through the use of appliances or materials that use less energy to achieve the same results, such as replacing a light bulb with a model that performs just as well but uses less energy to operate (EIA 2017).

Fossil fuel: A fuel formed when organic material (such as dead plants or animals) decomposes in an oxygen-free environment, and is subjected to intense heat and pressure over a very long period of time. Common fossil fuels include coal, petroleum, and natural gas (EIA 2017).

Global warming: See “climate change”

Global warming potential (GWP): A measurement of an individual greenhouse gas based on its ability to trap heat. All global warming potentials are measured in relation to carbon dioxide, which has a global warming potential of 1 (IPCC 2012).

Greenhouse gas (GHG): A gas that can accumulate in the atmosphere, where it traps heat close to the Earth’s surface. While some level of these gases is necessary to maintain a comfortable temperature on Earth, an increased concentration traps additional heat, resulting in climate change. Greenhouse gases can be emitted through both natural and human processes (IPCC 2012).

Methane (CH₄): A colorless and odorless greenhouse gas that traps 28 times as much heat in the atmosphere than carbon dioxide over a 100-year period. Methane is emitted by both natural and human-caused activities, including fossil fuel combustion, agricultural processes, and the decomposition of solid waste and wastewater.

Nitrous oxide (N₂O): A colorless greenhouse gas that traps approximately 265 times as much heat carbon dioxide in the atmosphere over a 100-year period. Methane is emitted by both natural and human-caused activities, including fossil fuel burning, agricultural and sewage treatment operations, and some industrial processes.

Photovoltaic (PV): A system that can produce electricity from sunlight, such as a solar panel.

Placer County Air Pollution Control District (PCAPCD): The organization responsible for local enforcement of California’s air pollution regulations, and taking additional locally appropriate action to improve air quality, within the boundaries of Placer County.

Regional Transportation Plan (RTP): A long-term plan for a region’s transportation systems, including roads and highways, public transit, and pedestrian and bicycle activities. These plans identify the region’s transportation needs, set out policies and investments to address these needs, and discuss the financial resources needed for implementation. Under state law, all metropolitan planning organizations must prepare a regional transportation plan.

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Renewable energy: Energy from sources that naturally replenish themselves over a short period of time, such as sunlight, wind, and organic waste products (EIA 2017).

Sacramento Area Council of Governments (SACOG): The metropolitan planning organization responsible for high-level transportation planning and land use coordination in the wider Sacramento area. The organization's jurisdiction covers most of Placer County, except for the Tahoe Basin.

Stationary source: A major fixed source of greenhouse gases, such as a power plant, refinery, or factory.

Tahoe Regional Planning Agency (TRPA): The metropolitan planning organization responsible for high-level transportation planning, land use coordination, and environmental protection in the bi-state Tahoe Basin. The organization's jurisdiction includes the Tahoe region of Placer County.

Vehicle miles traveled (VMT): A measurement of the total distances traveled by vehicles over a set period. It is used as a way of measuring the volume of transportation activity associated with a jurisdiction, and is increasingly used to determine the environmental impacts of individual projects.

Glossary Sources:

CARB (California Air Resources Board). 2017. "Glossary". <https://ww2.arb.ca.gov/about/glossary>.

EIA (United States Energy Information Administration). 2017. "Glossary". <https://www.eia.gov/tools/glossary/>.

IPCC (Intergovernmental Panel on Climate Change). 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation – Glossary of Terms*. https://www.ipcc.ch/pdf/special-reports/srex/SREX-Annex_Glossary.pdf.